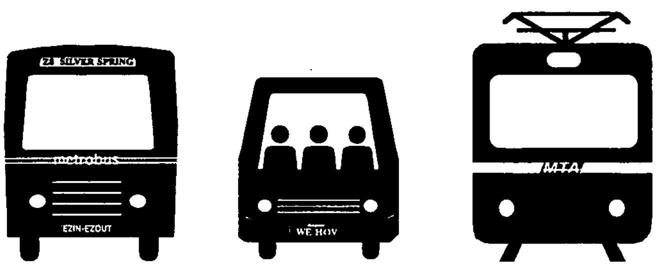
Transitway High-Occupancy Vehicle Network Master Plan

A long range multimodal plan to
increase County-wide mobility



Alternatives Report

TECHNICAL APPENDIX

January 1995

Prepared By
The Montgomery County Planning Department
8787 Georgia Avenue
Silver Spring, MD 20910-3760

ABSTRACT

TITLE:	Alternatives Report Technical Appendix of the Transitway and High-Occupancy Vehicle Network Master Plan
AUTHOR:	The Maryland-National Park and Planning Commission
SUBJECT:	Alternatives Report Technical Appendix of the Transitway and High-Occupancy Vehicle Network Master Plan
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ABSTRACT:	This publication is the Technical Appendix for the Alternatives Report of the Transitway and High-Occupancy Vehicle Network Master Plan. The Technical Appendix contains 12 supporting documents discussing: (1) the transportation modeling and evaluation process for both transitways and HOV facilities; (2) the data and transportation networks used in the evaluation; (3) transportation modes, including a comparison of several different modes and separate discussions of HOV, light rail transit, and busways; (4) planning and policy background to this Master Plan.

TECHNICAL APPENDIX

Transitway and High-Occupancy Vehicle Network Master Plan

ALTERNATIVES REPORT

Montgomery County Planning Department

THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION

8787 Georgia Avenue / Silver Spring, Maryland / 20910-3760

The Maryland-National Capital Park and Planning Commission

The Maryland-National Capital Park and Planning Commission is a bi-county agency created by the General Assembly of Maryland in 1927. The Commission's geographic authority extends to the great majority of Montgomery and Prince George's Counties; the Maryland-Washington Regional District (M-NCPPC planning jurisdiction) comprises 1,001 square miles, while the Metropolitan District (parks) comprises 919 square miles, in the two Counties.

The Commission has three major functions:

1. The preparation, adoption, and, from time to time, amendment or extension of the *General Plan* for the physical development of the Maryland-Washington Regional District;

2. The acquisition, development, operation, and maintenance of a public park system; and

3. In Prince George's County only, the operation of the entire County public recreation program.

The Commission operates in each county through a Planning Board appointed by and responsible to the county government. All local plans, recommendations on zoning amendments, administration of subdivision regulations, and general administration of parks are responsibilities of the Planning Boards.

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Notice to Readers

A functional master plan, following approval by the County Council and adoption by The Maryland-National Capital Park and Planning Commission, constitutes an amendment to the General Plan for Montgomery County. As such, it provides a set of comprehensive recommendations and guidelines for the use of publicly and privately owned land within its planning area.

County-wide functional master plans are intended to provide a benchmark point of reference with regard to public policy for a specific system. These plans cover such functions as overall circulation systems, parks and recreation facilities, environmental systems, agricultural preservation and such public services as fire and police stations and libraries. A functional master plan reflects a vision of future development for these systems that is balanced with the principal development objectives of the entire County.

Together with relevant master plans, a functional master plan should be referred to by public officials and private individuals when decisions are made that affect the facilities within the plan. It should be noted that functional master plan recommendations and guidelines are not intended to be specifically binding on subsequent actions, except in certain instances where documents such as the Zoning Ordinance or Subdivision Regulations require a specific condition to exist.

Functional master plans generally look ahead to a time horizon when the adopted area master plans will be fully developed. It is recognized that the original circumstances at the time of adoption of a functional master plan will change, and that the specifics of a plan may be viewed differently as time goes on.

Any sketches in an adopted functional master plan are for illustrative purposes only, and are intended to convey a general sense of desirable future character rather than any specific commitment to a particular detailed design.

***

Comments or questions regarding the Alternatives Report or the Transitway and High-Occupancy Vehicle Master Plan should be directed to:

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Citizens Advisory Committee
for the
Transitway and High-Occupancy Vehicle
Network Master Plan

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Lee Barnes

James Clarke

Frank Ephraim

Sharon Ferguson*

Tom Fuchs

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Barry Locke*

Peter Munson

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Harry Sanders

Edward Weisel

David Winstead

* Resigned

The Master Plan Development Process for the Transitway and High-Occupancy Vehicle Network Master Plan

Issues Report (Phase I) - This document, prepared by the Montgomery County Planning Department, identifies the broad range of issues to be addressed, the methodology to be employed, and the goals to be achieved in the development of the master plan. Additionally, the Issues Report describes the work program for the master plan process, including citizen participation. Once completed, the Issues Report is presented to the Montgomery County Planning Board for its review and consideration. Following the Planning Board's review, staff then proceeds to develop the Alternatives Report.

Alternatives Report (Phase II) - **The publication of an Alternatives Report is unique to the development of the Transitway and HOV Network Master Plan and is a major step in the development of the Staff Draft Plan. The Alternatives Report will contain a set of alternative network corridors to be evaluated and refined and will recommend that one of these network alternatives be approved by the Planning Board for further refinement and detailed delineation. Staff will hold public forums to present the recommendations of the Alternatives Report and to receive public comment. The Planning Board will have open worksessions to consider the staff recommendations and public comments before taking action on the Alternatives Report.**

Staff Draft Plan (Phase III) - This document is prepared by the Montgomery County Planning Department for presentation to the Montgomery County Planning Board. A Public Hearing (Preliminary) Draft Plan is then prepared for approval to go to public hearing by the Planning Board. The Public Hearing (Preliminary) Draft Plan incorporates those preliminary changes to the Staff Draft Plan that the Planning Board considers appropriate.

Public Hearing (Preliminary) Draft Plan - This document is a formal proposal to create or amend an adopted master or sector plan prepared by the Montgomery County Planning Board of the Maryland-National Capital Park and Planning Commission. It is prepared for the purpose of receiving public hearing testimony. Its recommendations are not necessarily those of the Planning Board. Before proceeding to publish a Planning Board (Final) Draft Plan, the Planning Board holds a public hearing. After closing the record of this public hearing, the Planning Board holds open worksessions to review the testimony and to revise the Public Hearing (Preliminary) Draft Plan.

Planning Board (Final) Draft Plan - This document is the Planning Board's recommended Plan. After October 1, 1992, changes in the Regional District Act require the Planning Board to transmit the Plan directly to the County Council with copies to the County Executive. The Regional District Act then requires the County Executive, within sixty days, to prepare and transmit a fiscal impact analysis of the Planning Board (Final) Draft Plan to the County Council. The Executive may also forward to the County Council any other comments and recommendations regarding the Planning Board (Final) Draft plan within the sixty-day period.

After receiving the Executive's fiscal impact analysis and comments, the County Council may hold a public hearing to receive public testimony on the Plan. After the close of record of this public hearing, the Council's Planning, Housing, and Economic Development Committee (PHED) holds open worksessions to review the testimony and revise the Planning Board (Final) Draft Plan. The County Council, after its worksessions, then adopts a resolution approving the Planning Board (Final) Draft Plan as revised.

Adopted Amendment - The Plan approved by the County Council is forwarded to the Maryland-National Capital Park and Planning Commission for adoption. Once adopted by the Commission, the Plan officially amends the various master or sector plans cited in the Commission's adoption resolution.

Transitway and High-Occupancy Vehicle Network Master Plan Development Process

Planning Board submits, and Council approves:

Annual Work Program

Planning Board appoints Citizen Advisory Committee. Planning staff initiates community participation and prepares:

Issues Report

Planning Staff reviews Issues Report with Planning Board, and then prepares:

ALTERNATIVES REPORT

Planning staff and CAC review Alternatives Report with Planning Board, staff then prepares:

Staff Draft Plan

Planning Board reviews Staff Draft and, with modification as necessary, approves plan as suitable for public hearing.

Public Hearing (Preliminary) Draft Plan

Planning Board reviews public hearing testimony, receives Executive comments at Board worksessions, and adjusts Public Hearing Draft to become:

Planning Board (Final) Draft Plan

Executive reviews Planning Board Draft and forwards fiscal impact analysis and comments to County Council.

Planning Board (Final) Draft Plan Transmitted to County Council

Council holds public hearing and worksessions and approves, disapproves or amends Planning Board Draft, which is forwarded to M-NCPPC to become

Approved and Adopted Master Plan

Technical Appendix

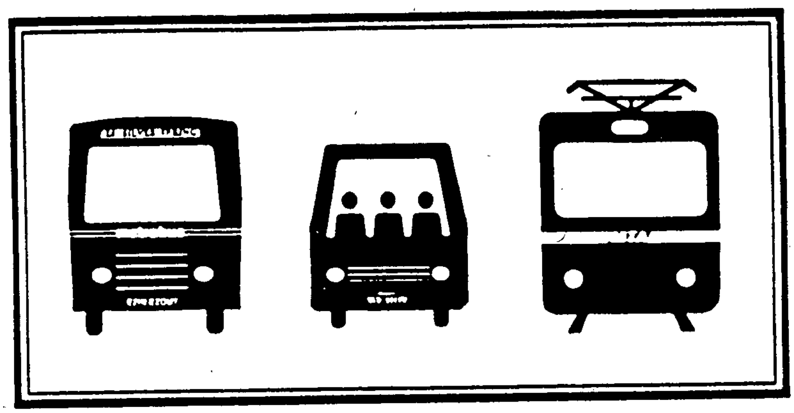
Alignment Evaluation Process

Washington Region in 2010: Transportation and Land Use

Modes of Transportation

Planning Policies

The Table of Contents (including maps, figures, and tables) is found on the inside cover of each appendix.



APPENDIX A

THE TRAVEL/2

TRANSPORTATION

MODEL

Appendix A

The TRAVEL/2 Transportation Model

Contents

Maps

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Appendix A The TRAVEL/2 Transportation Model

This appendix briefly explains the TRAVEL/2 transportation model and the assumptions and modeling methodology used in this analysis. For a more detailed explanation, see "TRAVEL/2: A Simultaneous Approach to Transportation Modeling," available at the Transportation Division of the Montgomery County Planning Department.

A. Modeling Basics

The TRAVEL/2 regional transportation model is designed to forecast travel demand, given a set of inputs detailing the land use patterns, demographic information, and transportation network facilities. Generally, a transportation model attempts to answer several questions that are of importance to planners and policy makers:

- How many people are traveling?
- Where are they going?
- What type of transportation are they using?
- What time of day do they make their trips?
- What route do they take?
- How much time does it take them to reach their destination?

TRAVEL/2 does not answer these questions by simulating the decisions of each individual making a trip. As an aggregate model, it instead statistically estimates travel demand based on observed travel behavior. Therefore, the more people being modeled, the more reliable the model's prediction.

Traffic Zones

Transportation models generally assign regional land use activity (jobs, households, and other demographic data) to traffic zones. Since TRAVEL/2 is an aggregate model, the "people" in the model do not travel from building to building, they travel between traffic zones. Two general characteristics can be applied to any traffic zone: it should not cross a major highway, and it should have relatively

homogenous land uses. Ideally, each traffic zone should also have roughly the same number of trips associated with it; thus, the more urban an area is, the smaller its traffic zones are. For instance, the Silver Spring CBD (area: 0.59 square miles) has three traffic zones, while the Damascus policy area (area: 9.60 square miles) has only two. There are 292 traffic zones within Montgomery County, as seen in Map A-1; 651 zones constitute TRAVEL/2's modeling region, shown on Map A-2.

All traffic in a zone comes from and goes to one single point in the zone. This point is known as a centroid because it is located as closely as possible to the traffic zone's geographic center. Since all traffic in a zone comes from the centroid, the model does not account for traffic within a zone. Fortunately, such trips make up only a small fraction of those taken.

Networks

The roadways, transitways, bike paths, and sidewalks in an area are represented by a computer network. The network comprises links representing portions of streets that are joined at nodes in spiderweb fashion, with the nodes representing intersections. The centroids discussed above are joined to the network by one or more connectors. Since not all streets are represented in the network, the trips from a given zone move between the centroid and the network by one of these connectors. Representation of traffic flow is better on major roads, where the cumulative effect of many zones is at work, than it is on local streets. The analyses in this Report are either County-wide or along major roads.

Individual network links are coded with information detailing the length, number of lanes, and vehicular capacity of the roads they represent. The freeflow speed is also coded onto a link and is determined by the roadway type. However, as discussed further below, the actual speed on a link decreases as the congestion on it increases.

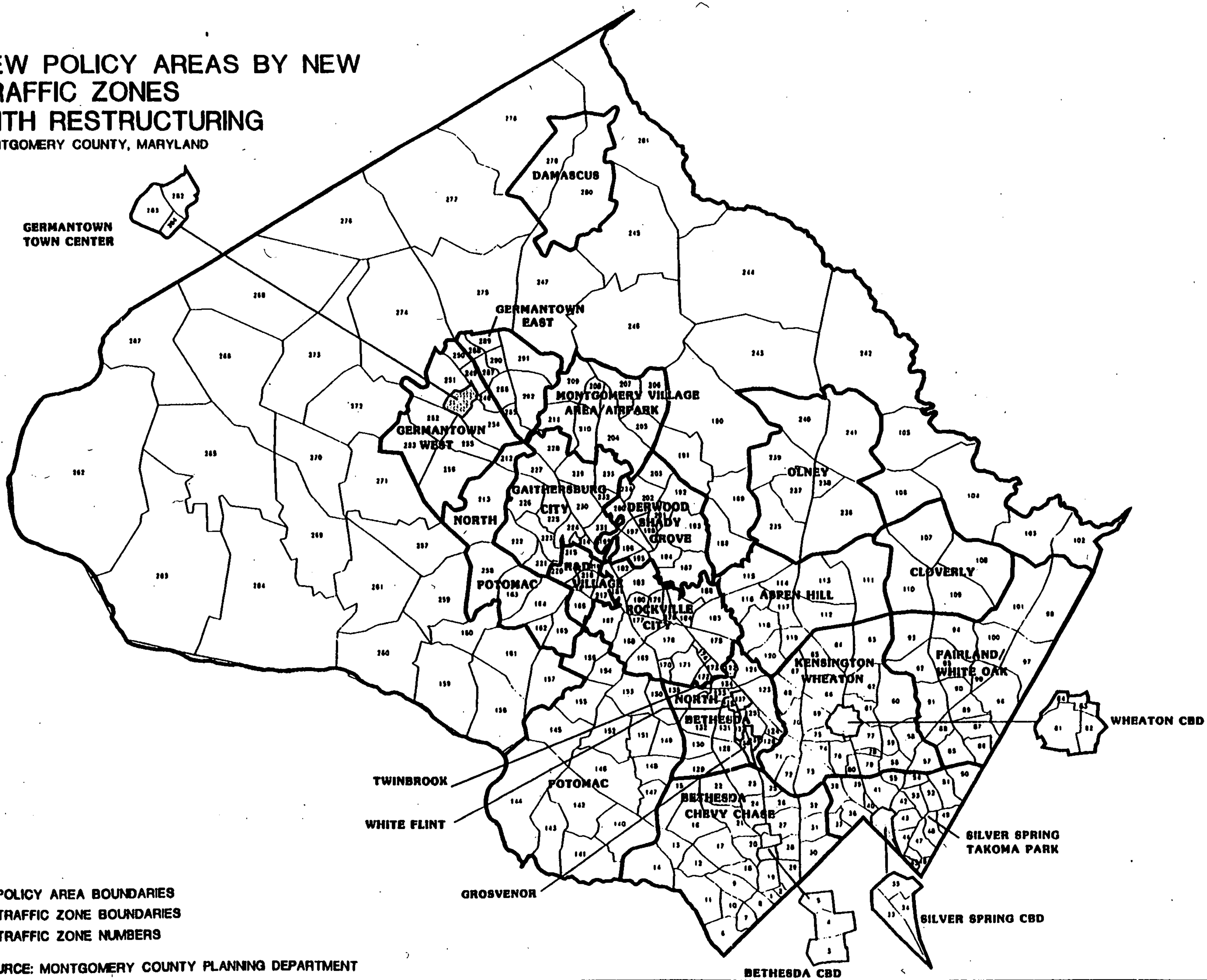
With the input of the Technical Advisory Committee (TAC), a background transit network was prepared for bus, Metrorail, MARC commuter rail service, and the three master-planned transitways. In most cases, bus routes share links with automobiles and other motorized vehicles on the roadway network. The background transportation network is described in Appendix E.

Separate links were also coded to represent facilities carrying high-occupancy vehicles only. They are similar to links representing regular roads, but allow only HOV vehicles. In this work, vehicles with two or more occupants qualified as HOVs. They were permitted to travel anywhere on the highway network as well as on the HOV links, but single-occupant vehicles were limited to non-HOV (or general purpose) roadway links.

The HOV links were connected by short road segments at each end of the link. No time penalty was imposed for entering or leaving the HOV facility, and the model did not specify whether the HOV facility was in the median, in an inside lane, or next

NEW POLICY AREAS BY NEW TRAFFIC ZONES WITH RESTRUCTURING

MONTGOMERY COUNTY, MARYLAND



— POLICY AREA BOUNDARIES

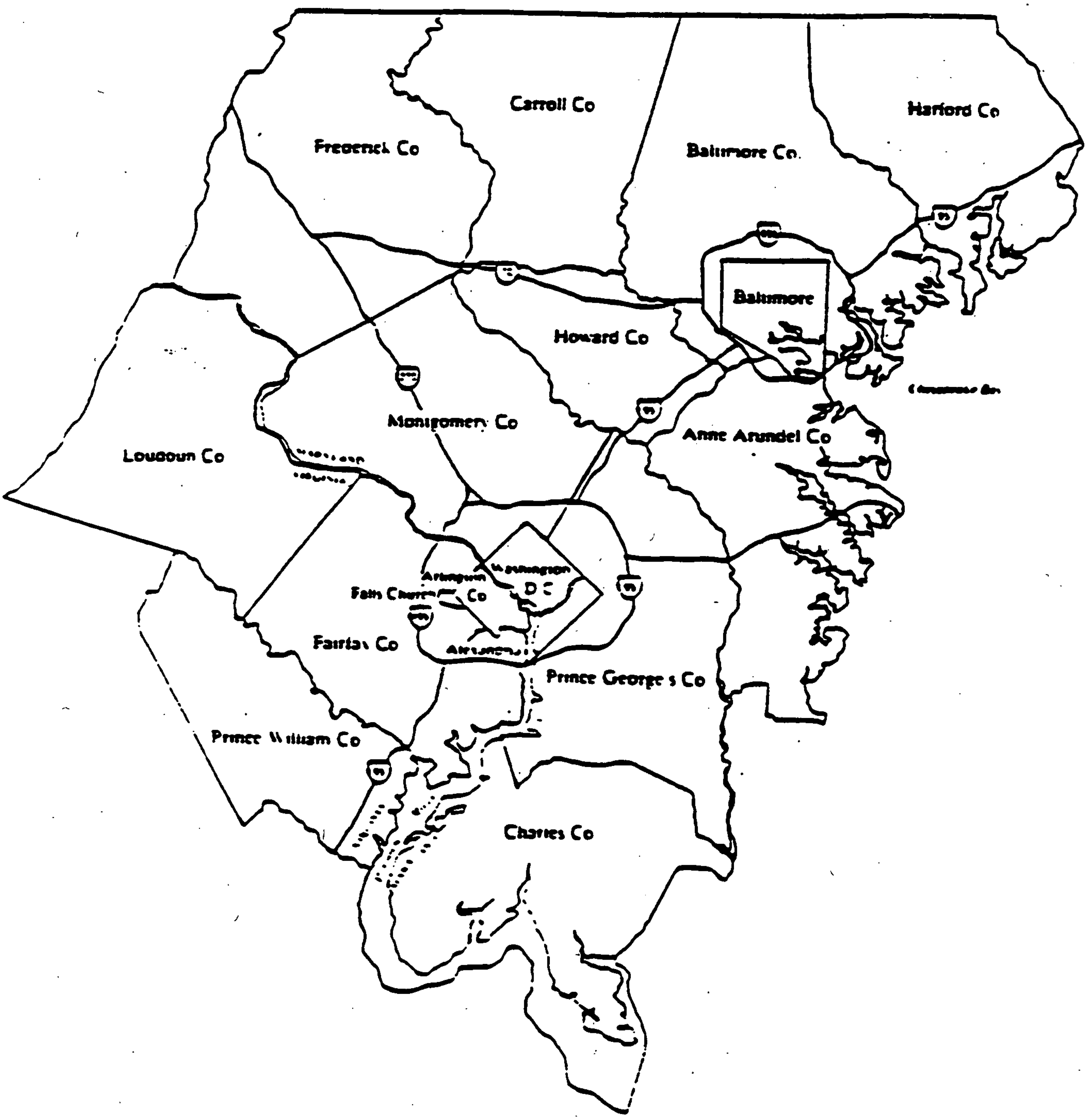
— TRAFFIC ZONE BOUNDARIES

244 TRAFFIC ZONE NUMBERS

SOURCE: MONTGOMERY COUNTY PLANNING DEPARTMENT

Map A-1

TRAVEL/2 Modeling Region



to the curb. In some cases, HOV lanes were added; in others, regular lanes were converted, or "optimized," from general use to HOV-only restrictions. Further discussion of HOV characteristics can be found in Appendix C and Appendix H.

Data

Data sets from the Metropolitan Washington Council of Governments (COG) Household Travel Survey, Montgomery County Planning Department (MCPD) Trip Generation Studies, the MCPD Census Update, the MCPD Travel Time and Delay Study, Metrorail Passenger Studies, and MCPD Traffic Counts databases were used to estimate, calibrate, and validate the model. Based on observed group travel behavior, population and employment data, and other socioeconomic data, the TRAVEL/2 computer model can estimate the aggregate travel behavior of the entire regional population.

B. Model Components

The structure of the TRAVEL/2 transportation model is graphically presented in Figure A-1. As seen, there are several aspects considered in estimating transportation demand. Each aspect can be thought of as answering one of seven questions:

TRAVEL/2 Model Components

Trip generation: How many people are traveling and for what purpose?

Destination choice: Where are they going?

Departure time choice: What time do they make the trip?

Mode choice: What type of transportation are they choosing?

Route assignment: Which route do they take?

Intersection control: How does delay at intersections differ from delay on roadways?

Feedback: How does congestion, or increased travel time, influence destination choice, departure choice, and route choice?

Trip Generation

The first step in the modeling process, trip generation, relates land use and demographic data to the creation of trips. In residential zones, the crucial factors are the number of households, dwelling type (single- or multi-family), number of persons

per household, and age of each person. Surveys in Montgomery County have determined that these are the main variables that account for the number of home-based trips. Employment zones are separated into office, retail, industrial, and "other" uses, and the crucial variable is the number of employees.

Destination Choice

Destination choice, or trip distribution, spreads the number of trips coming from each traffic zone among all possible destination zones. TRAVEL/2 uses a "gravity" model that distributes the trips between two zones based on three characteristics:

- Time: the greater the travel time between two zones, the fewer trips distributed between them,
- Opportunities: the greater the housing and employment opportunities in two zones, the more trips distributed between them, and
- Competition: the greater the number of people who share the same origin, the less likely those individuals can share the same destination.

The destination choice aspect of the TRAVEL/2 model is more sophisticated than most because, as discussed below, it re-calculates — or feeds back — the destination choice with congested travel times as input. This means that destination choice is influenced by congestion. The feedback process may go through as many as 25 iterations.

Departure Time

Person trip volumes are calculated by the trip generation process for a three-hour afternoon peak period, but the auto assignment that completes the modeling is for the afternoon peak hour. Departure time, a special feature of the TRAVEL/2 model, uses travel survey data to determine the fraction of afternoon trips that will occur during the 4:30-5:30 peak hour. As the network becomes more congested, some trips may begin earlier or later to avoid peak hour congestion.

Transportation Planning Model with Feedback

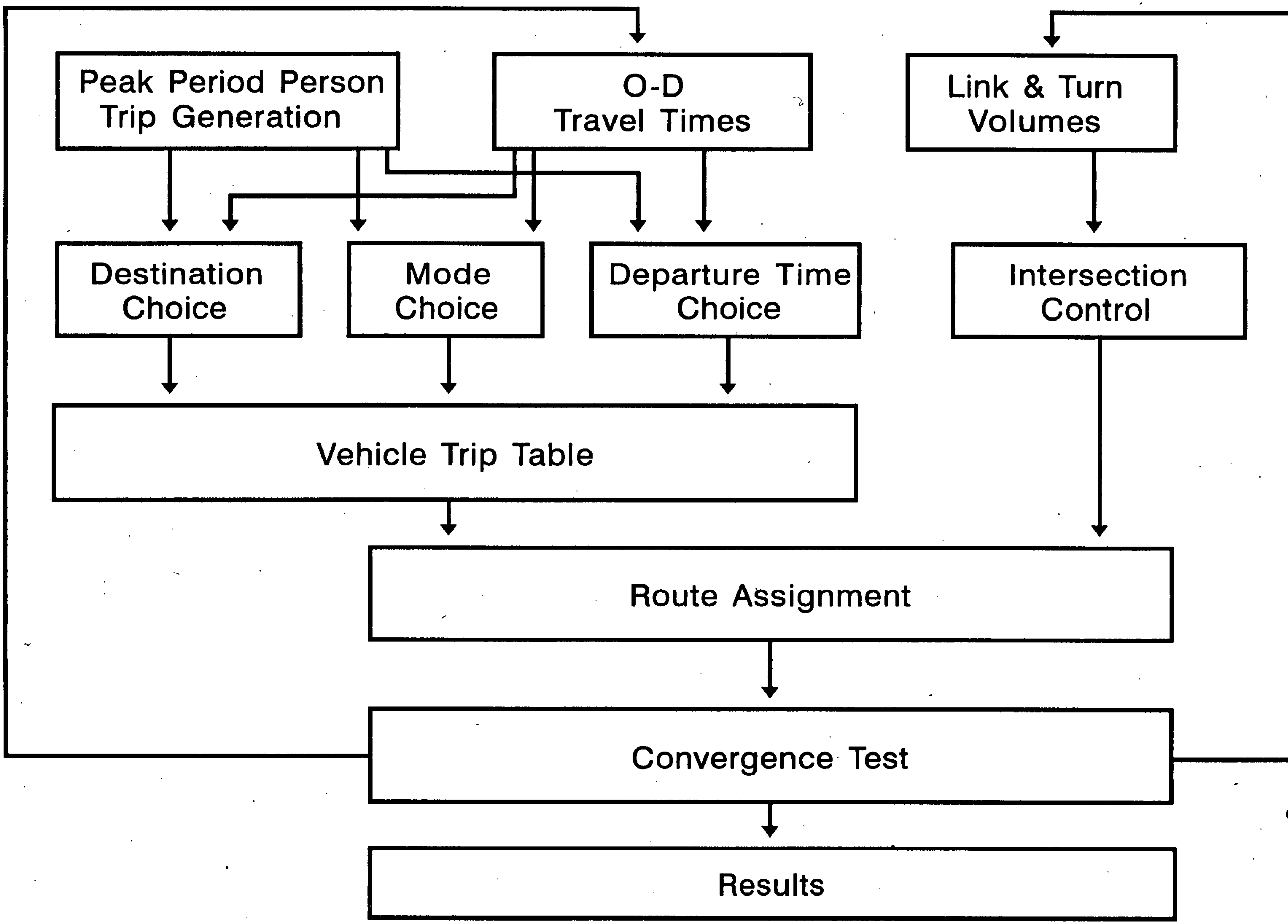


Figure A-1

Mode Choice

Mode choice calculates the probability of using a particular mode of transportation. In the TRAVEL/2 model, mode choice is carried out in parallel with the distribution and departure time calculations. It essentially compares both the travel time and out-of-pocket cost of a certain trip for seven separate modes:

1) walking to transit;
2) driving to transit (park and ride);
3) receiving a ride to transit (kiss and ride);
4) driving alone;
5) traveling in a 2-person carpool;
6) traveling in a carpool with 3 or more persons;
7) walking or bicycling.

A probability is then assigned for using each of the modes for all trips between two particular traffic zones. This probability takes into account the density of housing where the person lives, auto ownership, sidewalk availability, and, for rail transit, the percent of households and jobs in the zone that are within walking distance of a station. For this use of the TRAVEL/2 model, transit costs were refined to reflect zonal bus fares, as well as rail distance in the case of Metrorail, MARC, and light rail service. The ratio between out-of-pocket costs for transit and auto use was kept at 1990 levels.

Route Assignment

In transportation demand models, the last step is usually route assignment, where a specific path for each trip on the network between its origin zone and destination zone is determined. The first iteration simply places each trip on an optimal network path — that path with the shortest travel time — based on freeflow link speeds; congestion is not yet a factor in travel time. After the first iteration, the delay is calculated resulting from the roadway capacity and intersection restraints. As a result of the delay, a fraction of the total trips may move to different paths. The delay is then recalculated for the third iteration. In this model, this iterative assignment process seeks an equilibrium, or a state in which all paths used between an origin-destination pair have roughly equal travel times.

For trips that involve transit use, total travel time includes walking or driving to the transit stop or station, boarding, transferring, etc. The model tries to find the optimal travel time for all transit users, just as it does for auto users.

Intersection Delay

An innovative feature of the TRAVEL/2 model is its calculation of intersection delay as traffic is put on the network. This delay is then included in the travel time calculations, influencing demand on the network. Intersection delay is an important

element in modeling travel demand since certain intersections, especially those with many turning movements, influence travel time more than a normal intersection. Examples of delay calculations include the effects of vehicles turning left in front of opposing traffic and the availability of a dedicated left-turn lane versus a shared lane in which vehicles must queue behind the vehicle turning.

Feedback

Feedback is the engine of the TRAVEL/2 computer model, and its use of feedback is one of the most rigorous in the country. TRAVEL/2 uses an iterative procedure to estimate travel demand, the impact of the demand on travel time, and the changes in travel demand that result from changed travel times due to congestion. This enables an estimate of demand to influence travel time and vice versa, meaning that the travel time between two points is not fixed in advance and varies depending on the level of congestion on the transportation network under test.

C. Measures of Evaluation

Given the purpose of the Transitway and HOV Network Master Plan, several new tools had to be developed to evaluate County-wide transportation networks and the relative contribution of specific facilities to those networks. One of these is a measurement tool that allows the County-wide and regional impact of transitways to be calculated.

The primary criteria from the TRAVEL/2 transportation model were County-wide accessibility and the demand on each alignment being tested as well as on existing facilities, such as Metrorail.

Accessibility

Because the Transitway and HOV Network Master Plan is a multimodal study that has the aim of increasing County-wide mobility, staff developed a new method for comparing different networks. The aim of this modeling effort was to determine the contribution of each alignment to the overall mobility of Montgomery County residents and workers. The primary criterion staff used to evaluate each facility's contribution to overall mobility was accessibility.

Briefly, accessibility deals with opportunities. An opportunity is simply a job that can be reached from a household within a certain period of travel time. (Since TRAVEL/2 models the evening peak period, most people are traveling from work to home.) The more opportunities reached in the same travel time, the higher the accessibility. The calculation of accessibility is examined at two levels: the traffic zone and the County. In addition, accessibility is calculated for each of three modes: single-occupant vehicles, high-occupancy vehicles (two or more occupants), and

transit. Issues relating to transit accessibility can be found in Appendix B while HOV accessibility is explored in Appendix C.

One of the benefits of using accessibility as a measurement is that, given the capabilities of TRAVEL/2, opportunities are easily quantified. Two separate accessibility indices, JOBS and LABOR, are first determined for each traffic zone. Simply, JOBS relates to those who live in Montgomery County while LABOR relates to those who work in Montgomery County. More explicitly, JOBS accessibility specifies how effective the transportation network is at moving Montgomery County residents in a traffic zone between their jobs in the Baltimore-Washington metropolitan region and their homes during the evening peak period. LABOR accessibility indicates how well the transportation network moves people between their jobs in a Montgomery County traffic zone to their homes anywhere in the region, also during the evening peak hour. The differences between the two are indicative of the regional context of the transportation network. There is some overlap in the two parts of the index, when people both live and work within the same traffic zone, but the overlap does not affect the results. The accessibility measure presented in this Report is a combination of JOBS and LABOR.

Accessibility is calculated for each of the residences in a traffic zone by multiplying the number of jobs in each of the other traffic zones in the region by an "impedance," or "friction," factor, and then summing the total for all the residences. Impedance is determined by the travel time between traffic zones. The impedance factor weighs close jobs more than distant jobs, and has been estimated from travel surveys. This factor, measuring the proportion of commuters who engage in trips of various durations, is very stable over time, being statistically unchanged between 1968 and 1988. The mode-specific equations underlying this factor are presented in the TRAVEL/2 documentation and are used in the destination choice component of the model.

The County-wide accessibility is determined by averaging the accessibility for each traffic zone. This index measures the mobility of Montgomery County residents and workers, gauging the efficiency of the County's transportation network as well as its regional ties. If the network is modified, such as through the addition of an alignment to be evaluated or a combination of alignments, the index will reflect the change. It will also indicate whether the modification is beneficial or detrimental to the network by comparing the index before and after the change. A more exact description of the how impact of each alignment on the accessibility index was derived can be found in the discussions of the alternative evaluation process in Appendix B and Appendix C.

Facility Demand

The TRAVEL/2 model computed demand on both the alignments being evaluated and existing facilities. This demand as measured on existing facilities, such as Metrorail, can be thought of as "ridership" for the forecast year because the

TRAVEL/2 model went through an extensive calibration phase using observed data that enabled it to more accurately forecast ridership.

However, it should be understood that demand calculated for the alignments being evaluated does not correlate as precisely to ridership as it does for currently existing facilities, such as Metrorail. This evaluation process used a large-scale, regional analysis; future project planning studies, with the exact determination of the alignment from the adopted Network Master Plan, will be able to do a much smaller scale examination. Staff primarily used these demand computations for the evaluated alignments in the segments and junctions phase of analysis (see Appendix B) for relative comparison rather than as an absolute benchmark.

This measure could also be used to determine relationships between alignments, or networks of alignments, and existing facilities. If, for instance, the presence of an alignment increased Metrorail ridership less than the presence of another alignment, this was taken into consideration in the evaluation process.

Demand for analysis done in the later phases was measured in passenger miles of travel per mile of transitway. Passenger miles of travel (PMT) is a measure used throughout the transit industry to evaluate a transitway's effectiveness. It weights the number of passengers by the length of each passenger's trip: one passenger traveling eight miles (eight PMT) is equivalent to four passengers traveling two miles (eight PMT). Dividing PMT by the length of the transitway gives an average demand, making it easier to compare transitways of different lengths.

D. Input Assumptions

The TRAVEL/2 model requires that input assumptions be made for a number of factors that influence mode choice as well as other aspects of travel behavior. One criticism of the use of transportation models regarding these assumptions is often that transit demand is artificially boosted by various changes, including land use densification, and increased parking charges or gas price increases to make transit relatively cheaper. No such changes were used in this process. Input assumptions include:

Land Use

This application of the TRAVEL/2 model used the Round 4.1 COG forecasts for employment, population, and household distribution for 2010. This forecast, developed for COG by staff in the Planning Department's Research and Information Systems Division, as well as by planning departments around the region, provided population, household, and employment information for Montgomery County and for the other jurisdictions within COG's boundaries. These land use data were then assigned to the County's 292 traffic zones. A summary of regionwide data and trends from the Round 4.1 forecasts is found in Appendix F.

Higher densities of employment and population are generally associated with higher transit usage, although the degree of this relationship depends of a variety of factors. However, this Master Plan's scope does not encompass any changes to land use densities. Decisions regarding supporting land use policies will be made by the area master plan in which an alignment is located rather than by this Master Plan.

In conducting analyses on alternative transitway and HOV alignments, land use assumptions remained consistent so each alignment (or combination of alignments) could be measured for its contribution to the overall mobility for an area with consistent land use patterns.

Related Public Policies

One way to decrease use of the automobile in suburban areas where transit is available is to raise the price on gasoline or parking, or to enact a system of pricing that would charge users of major roads. This would encourage people to utilize transit since, by comparison, it would be cheaper. This Master Plan's scope did not include the modification of public policies, such as pricing influences, in the modeling process. In TRAVEL/2, the relationship between the out-of-pocket costs of transit and driving remained constant at 1990 levels for the evaluations used in developing the recommendations of this Report.

Future Highway and Transit Network

Prior to evaluating the accessibility of each proposed HOV and transit alignment, a background transportation network for 2010 was developed. The background transportation network incorporates reasonable assumptions about new roads and transitways that will be completed between now and 2010. The Technical Advisory Committee (TAC) provided input to the establishment of the background network. Assumptions were also made concerning improvements to the existing transportation system.

This background transportation network also incorporates future transit and HOV systems. Examples of these additions include:

- an HOV 2+ facility on I-270 and its spurs;
- the Georgetown Branch;
- the North Bethesda Transitway; and
- the Corridor Cities Transitway.

A complete list of additions to the transportation network that are assumed to be built between now and 2010 is presented in Appendix E.

The background network remained constant so each alignment (or combination of alignments) could be measured for its contribution to the overall mobility of an area with the same transportation facilities except for the alignment being tested.

Occasionally, the characteristics of a background facility were modified to integrate it with an alignment being evaluated. Such changes are explicitly noted where they have occurred.

Build-Out

Forecasting requires a stable timeframe of analysis to produce reliable results. Regarding this, the Issues Report stated: "The evaluation of the alternative network combinations... will be made in relation to two future times: the year 2010 and the 'build-out' of the approved master plans." (p. 17) In general, build-out is the state of development, an unknown number of years in the future, where the zoning capacity of a master plan area is fulfilled. The Issues Report referred to build-out as the state where every master plan in Montgomery County has filled its zoning capacity. Build-out had been expected to be included in the analysis for this Master Plan for two reasons: the Transportation Network Studies, the precursor to this Master Plan, based its decisions on build-out, and certain master plans, especially recently, have tested the adequacy of their transportation facilities at build-out within their planning area.

It is appropriate for area master plans to provide a balance between the traffic generated by its recommended land uses and the capacity of the recommended transportation network. However, staff eliminated the build-out timeframe of analysis from this Master Plan's consideration for several reasons, including the following:

- It is a theoretical event that will never be achieved because the master plans are amended on a fairly routine cycle;

- The master plan horizons for build-out differ for the down-county planning areas and the up-county planning areas, resulting in a patchwork of timeframes across the County and making it impossible to gauge projected effectiveness of a County-wide network;

- Individual behavior changes, macroeconomic policy changes, and unforseen technological advances may expand or alter choices regarding transportation options in the future. The longer the time into the future, the greater the uncertainty;

- No assumptions regarding development in jurisdictions outside Montgomery County can be made consistent with build-out in Montgomery County because of the uncertain timeframe; and

- There are fewer employment zoning classifications than there are for residential uses. Therefore, existing employment zones encompass a wider range of options, allowing employers to adjust to changes in the market. Montgomery County employment zones have high ultimate potential capacities, even though only a fraction of that potential is normally used. As a result, testing the zoning capacity for both

housing and jobs results in an unrealistic excess of jobs or a drastic shortage of housing. Irrational travel patterns would emerge due to the number of workers who must enter Montgomery County from every direction to satisfy the excess employment capacity.

APPENDIX B

TRANSITWAY

EVALUATION

PROCESS

Appendix B

Transitway Evaluation Process

Contents

Maps

Tables

Appendix B Transitway Evaluation Process

This section describes the methodology used in evaluating the transitway alignments. This includes the measures of evaluation, the steps of the process used to successively eliminate unsuccessful alignments, and the issues taken into consideration when planning the network.

A. Transitway Measures of Evaluation

Several measures were used to evaluate transitway alignments. One of the most important, accessibility, is outlined in Appendix A and also described in Appendix 4. The transitway evaluation did not deal with exactly the same measures as HOV evaluation because of differences between the modes: for instance, the speed of transitway vehicles was constant while HOV travel times could vary according to the level of congestion.

Transit Accessibility

As mentioned in Appendix A, the transportation model calculates an accessibility index for each of three modes: SOV, HOV, and transit. If more frequent or expanded transit service is brought to an area, that area has the potential to reach more opportunities via transit. However, if the transit service is not markedly improved, the transit accessibility index will not rise appreciably.

The transit accessibility index comprises several different modes of transportation, including walking/bicycling. The breakdown of the transit accessibility index with only those facilities in the base transportation network is seen in Table B-1.

The transit accessibility figures presented in Section 2 represent the percent increase of both the JOBS and LABOR transit accessibility indices combined: a 2.3 percent increase in transit accessibility means that the JOBS index plus the LABOR index increased by 2.3 percent. This could mean that each increased by 2.3 percent,

Table B-1
Composition of the Transit Accessibility Index

Mode	Percentage
Bus	34
Metrorail	33
Walk/Bicycle	16
MARC	9
Master-planned Transitways[1]	8

[1] Georgetown Branch, North Bethesda Transitway, Corridor Cities Transitway

or it could mean that one increased 3.0 percent and the other increased by only 0.5 percent (the JOBS and LABOR indices are not of equal size). In any case, it should be remembered that any increase to the transit accessibility is done on the margins, or in excess of what already exists. As more opportunities to take transit become available, the more difficult it is to improve the system by large amounts.

Transit Demand

As discussed in Appendix A, the demand forecast by the TRAVEL/2 regional transportation model does not take several factors into consideration that would make it a reliable predictor of "ridership." This level of analysis has instead strived to highlight those alignments that will have a substantial impact on Montgomery County's transit accessibility. Future project planning studies, with the exact delineation of the alignment and the ability and time to account for other factors, will be able to focus more on detailed ridership estimates.

Transitway demand is used in this Report as a comparative, rather than absolute measure of potential ridership. We cannot compare the transitway alignment demand figure with the demand on an existing transit line such as Metrorail because Metrorail ridership has been calibrated in the transportation model. As discussed in Appendix A, model calibration entails adjusting the model's predictions by a known value or set of values, usually determined from actual ridership or survey data. Therefore, while the transitway alignment demand figures presented in Section 2 can be compared to one another, they cannot be compared to Metrorail or bus ridership figures.

The demand on the evaluated transitways is measured as passenger miles of travel (PMT) per mile of the transitway. While this might seem a bit confusing, it should help to compare it with other potential measures. Two of these are:

- Total PMT on transitway: While this measurement generates a large number, it only muddles the issue. It is difficult to use it as a basis for comparison because shorter alignments are at a disadvantage.

- Peak link of transitway: Every alignment evaluated possessed a link or series of links that exhibited substantially more demand that the alignment on the whole. While this would have made it easier to justify each alignment, it is fundamentally misleading. The judgement to preserve right-of-way for a transitway must be done with the knowledge of the entire transitway's performance.

Effects on Existing Transit Services

Since the alignments recommended for further study by this Master Plan are intended not to supplement existing facilities but complement them, another measure of evaluation was the effect of an alignment or combination of alignments on Metrorail and MARC ridership. This is measured in the percentage increase in passenger miles of travel (PMT) on the particular transit facility.

Transitway Measures of Success

Appendix D lists and describes several non-quantitative evaluation measures considered in this analysis.

B. Transitway Evaluation Methodology

All of the proposed alignments except two were evaluated as either a potential light rail line or busway. One of the earliest problems in transitway evaluation derived from the unreasonably high number of possible networks that could be created by combinations of potential alignments. To evaluate each of these networks separately would require an unacceptable amount of both staff and computer time. For that reason, the analysis was broken down into several phases to reduce the number of alignments remaining under consideration successively. The goal of this reduction process was to screen out those alignment attracting little demand and determine the paths that benefitted County-wide mobility the most and showed the greatest demand for a transitway in the County.

Segments and Junctions (Map B-1)

The problem at this stage of the analysis was to minimize resource usage but still provide the comprehensive level of analysis necessary to significantly reduce the number of alignments to those of highest demand. The much smaller potential number of networks from the reduced set of alignments could then be tested. To

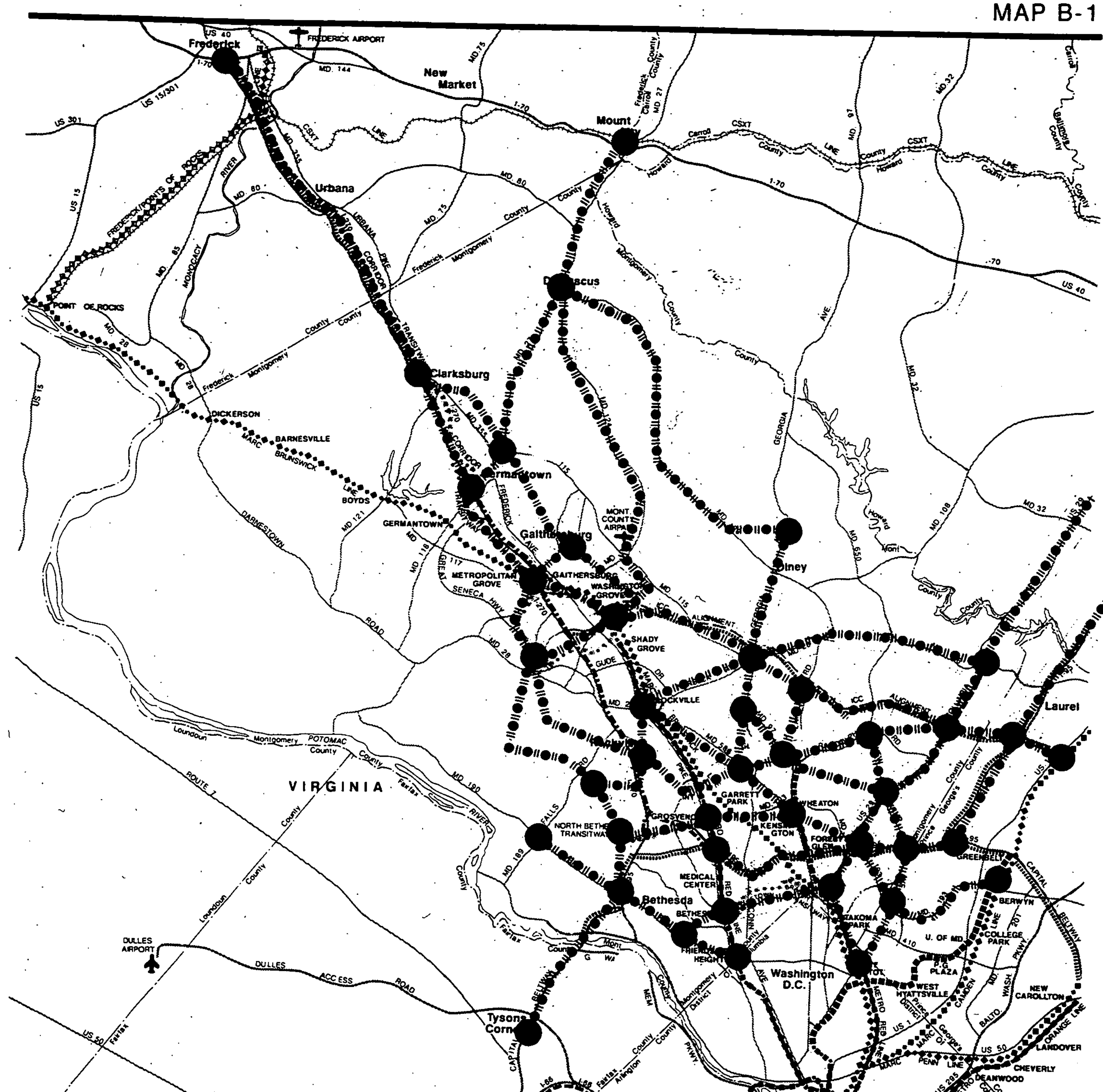
solve this problem, staff developed a method called "Segments and Junctions." In this method, all of the alignments were mapped, as were several connecting links between them. Each intersection of two or more segments was termed a junction and the portion of an alignment between two junctions a segment. See Map B-1 for a display of the segments and junctions.

To ensure no segment had an advantage over another, every segment had similar characteristics. Each segment was treated as a transit facility with no specific mode, referred to as "Mode X." Mode X vehicles traveled on the segments at 45 mph, had a headway — the time between vehicles — of 10 minutes, and could accommodate any demand placed on them. Further, a minimal transfer time — 0.1 seconds — was assessed at each junction so that the travel demand would be assigned to those segments on the path with the shortest travel time for the most people. This way, no segment would be unduly penalized due to the transfers required to reach it. Finally, junctions that were geographically close to one another — such as the junctions that existed initially at Georgia Avenue (MD 97)/Norbeck Road (MD 28), Georgia Avenue (MD 97)/Intercounty Connector, and at Norbeck Road (MD 28)/Intercounty Connector — were compressed into one junction for analytical simplicity.

Through this technique, staff was able to determine the unimpeded demand for additional transit in Montgomery County. As mentioned previously, this type of demand is not an estimation of ridership on the particular alignments, but rather a relative gauge of how well alignments fared with certain barriers (such as transfer penalties) removed. A total of 64 segments and 39 junctions were established from the alignments to be evaluated. A list of all the segments can be found in Table B-2.

These and all following transitway tests were conducted in a network that included future roadway and transit facilities as well as HOV facilities on regional freeways such as I-270 in Montgomery County and the Capital Beltway (I-495) in Virginia. A detailed description of this background transportation network can be found in Appendix E.

If a set of segments did not attract enough demand, it was dropped from further analysis. The threshold for elimination was set based on a judgement of performance of the network composed of segments and junctions. This threshold was set quite low in recognition that future evaluations would take into account factors that would increase anticipated travel demand. Moreover, if two segments roughly parallelled one another but both were slightly under the threshold, staff eliminated only one with the expectation that the other would attract at least a significant portion of the demand from the eliminated segment. However, even with this low threshold, 49 of the 64 segments comprising most or all of 12 of the 17 possible transitway alignments were eliminated through this phase of the evaluation process. Of the seven alignments for further evaluation as transitways, two were portions of larger



SEGMENTS AND JUNCTIONS

			Existing	Planned	Proposed
SEGMENTS		METRORAIL			
		MARC AND VIRGINIA RAIL EXPRESS			
JUNCTIONS		TRANSITWAY			
		CSXT AND AMTRAK			
		HOV LANES			

NORTH

9,000 0 9,000 18,000 27,000

1 0 1 2 3 4

TRANSITWAY AND HOV NETWORK MASTER PLAN

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Table B-2
Segments and Junctions

	Description	Length
SEGMENTS KEPT FOR FURTHER EVALUATION		
1	Georgia Avenue from Olney at MD 108 to the ICC	2.75
2	Georgia Avenue (MD 97) from the ICC to the Glenmont Metro station	4.50
3	New Hampshire Avenue (MD 650) at US 29 to the Wheaton Metro station	3.25
4	Wheaton Metro station to Grosvenor Metro station	3.50
5	US 29 from MD 198 to the ICC	3.25
6	US 29 from the ICC to New Hampshire Avenue (MD 650)	4.50
7	US 29 from New Hampshire Avenue (MD 650) to University Boulevard (MD 193)	2.00
8	US 29 from University Boulevard (MD 193) to Silver Spring	2.25
9	From River Road (MD 190) at the Capital Beltway (I-495) to the Bethesda Metro station	4.50
10	Capital Beltway (I-495) from the George Washington Parkway to Tysons Corner	8.25
11	Veirs Mill Road (MD 586) from Georgia Avenue (MD 97) to Randolph Road	3.50
12	Veirs Mill Road (MD 586) from Randolph Road to the Rockville Metro station	4.25
13	Randolph Road from the Glenmont Metro station to Veirs Mill Road (MD 586)	1.75
14	Randolph Road from Rockville Pike (MD 355) to Veirs Mill Road (MD 586)	2.00
15	Norbeck Road (MD 28) from Georgia Avenue (MD 97) to the Rockville Metro station	5.25
SEGMENTS NOT KEPT FOR FURTHER EVALUATION		
1	Ridge Road (MD 27) from Midcounty Highway (M-83) to Mount Airy	12.25
2	Midcounty Highway from Ridge Road (MD 27) to ICC	8.75
3	Corridor Cities alignment from Ridge Road (MD 27) to Clarksburg	2.25
4	Between Midcounty Highway (M-83) and Corridor Cities Transitway near Clarksburg	0.75
5	Corridor Cities alignment between Midcounty Highway (M-83) and Ridge Road (MD 27)	3.50
6	Capital Beltway (I-495) from University Boulevard (MD 193) to New Hampshire Avenue (MD 650)	2.25
7	University Boulevard (MD 193) from US 29 to New Hampshire Avenue (MD 650)	2.75
8	Capital Beltway (I-495) from New Hampshire Avenue (MD 650) to Kennilworth Avenue (MD 201)	4.50
9	University Boulevard (MD 193) from New Hampshire Avenue (MD 650) to Kennilworth Avenue (MD 201)	3.75
10	Wootton Parkway from Montrose/Wootton connection to Darnestown Road (MD 28)	2.75
11	Falls Road (MD 189) to Montrose/Wootton connection	2.75
12	Falls Road (MD 189) to Darnestown Road (MD 28) via PEPCO right-of-way	6.50
13	University Boulevard (MD 193) from US 29 to Georgia Avenue (MD 97)	3.00
14	River Road (MD 190) at Goldsboro Road to Old Georgetown Road (MD 187) in the Bethesda CBD	2.75
15	Capital Beltway (I-495) from Old Georgetown Road (MD 187) to Georgia Avenue (MD 97)	4.25
16	Capital Beltway (I-495) from US 29 to Georgia Avenue (MD 97)	1.75

Table B-2
Segments and Junctions (continued)

	Description	Length
SEGMENTS NOT KEPT FOR FURTHER EVALUATION (continued)		
17	ICC from Georgia Avenue (MD 97) to former Rockville Facility right-of-way	3.75
18	ICC from former Rockville Facility right-of-way to US 29	4.25
19	ICC from Baltimore Avenue (US 1) to US 29	5.00
20	MD 28/MD 198 Connector from Georgia Avenue (MD 97) to US 29	8.25
21	ICC from Georgia Avenue (MD 97) to Shady Grove Metro station	6.25
22	Former Rockville Facility right-of-way from the ICC to the Glenmont Metro station	2.50
23	Randolph Road from New Hampshire Avenue (MD 650) to the Glenmont Metro station	3.00
24	Fairland Road from New Hampshire Avenue (MD 650) to US 29	2.50
25	River Road (MD 190) from the Capital Beltway (I-495) to Falls Road (MD 189)	3.50
26	PEPCO right-of-way from Montgomery Mall to Falls Road (MD 189)	3.00
27	From Montgomery Mall to junction near Seven Locks Road and River Road (MD 190)	1.25
28	New Hampshire Avenue (MD 650) from University Boulevard (MD 193) to the Capital Beltway (I-495)	2.50
29	New Hampshire Avenue (MD 650) from University Boulevard (MD 193) to the Fort Totten Metro station	3.00
30	New Hampshire Avenue (MD 650) from the Capital Beltway (I-495) to US 29	2.25
31	Old Georgetown Road (MD 187) from Democracy Boulevard to the Bethesda CBD	5.00
32	Montrose Road from Rockville Pike (MD 355) to Montrose/Wootton connection	2.50
33	Randolph Road Bypass from the Glenmont Metro station to New Hampshire Avenue (MD 650) and south to US 29	3.75
34	New Hampshire Avenue (MD 650) from Randolph Road to US 29	2.00
35	Corridor Cities alignment from Darnestown Road (MD 28) to Clarksburg	8.50
36	I-270 from Frederick to Clarksburg	14.75
37	Adelphi Road between New Hampshire Avenue (MD 650) and University Boulevard (MD 193)	5.25
38	Connecticut Avenue (MD 185) from Veirs Mill Road (MD 586)/Randolph Road to Georgia Avenue (MD 97)	2.50
39	Montrose Road to Wootton Parkway connection	0.50
40	New Hampshire Avenue (MD 650) from the ICC to Randolph Road	1.25
41	River Road (MD 190) from Friendship Heights to the Capital Beltway (I-495)	4.50
42	Clara Barton Parkway/Cabin John Parkway from Washington, D.C. to the Capital Beltway (I-495)	4.50
43	US 29 from MD 100 to MD 198	12.25
44	I-95 from the Capital Beltway (I-495) to the Baltimore Beltway (I-695)	28.25
45	Wootton Parkway from the Rockville Metro station to Montrose/Wootton connection	1.75
46	MD 124 from Damascus to the Shady Grove Metro station	13.50
47	Rail right-of-way from the Shady Grove Metro station to the Metropolitan Grove MARC station	4.25
48	MD 108 from Olney to Damascus	12.50
49	Dulles Toll/Access Road from the Capital Beltway to Dulles Airport	11.75

TOTAL LENGTH OF ALL 64 SEGMENTS 310.25

alignments: only the piece on Norbeck Road (MD 28) from Georgia Avenue (MD 97) to the Rockville Metro station was kept from Alignment O, and only the piece on Veirs Mill Road (MD 586) from the Wheaton Metro station to the Rockville Metro station was kept from Alignment B.

Seven Routes

After the first phase of the evaluation process, the segments comprising the remaining alignments were joined together to make seven routes. The resulting routes can be seen in Map B-2.

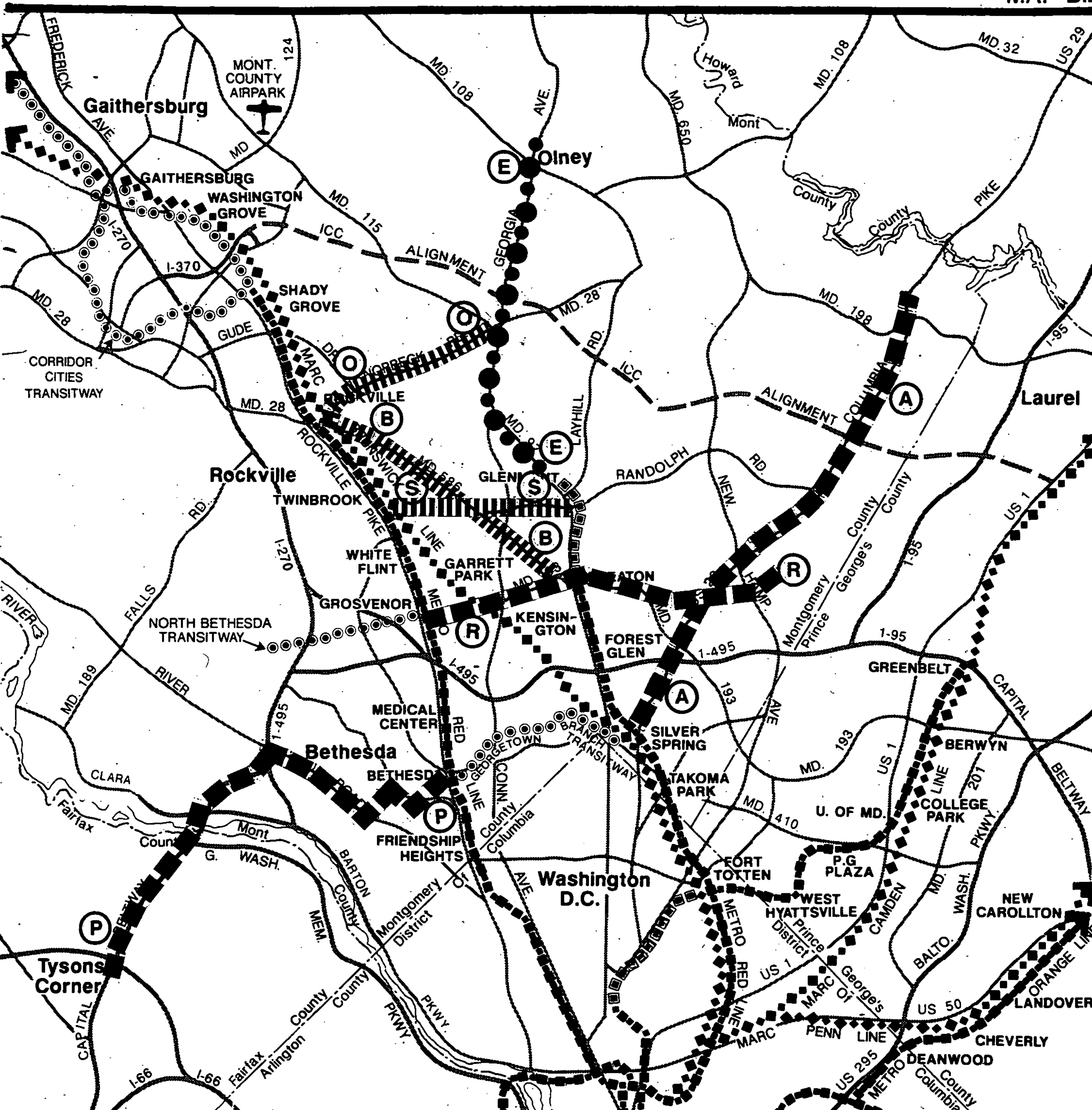
Throughout the tests of these routes, staff measured the impact of each route on County-wide accessibility in two different fashions. Measurement by subtraction entailed finding the accessibility index of the transportation network that included all seven routes in addition to the background transportation network. Each route was removed from this full network and the accessibility index recomputed. The difference between the full network accessibility index and the accessibility index for the full network minus the route was the impact for that route. Addition involved finding the accessibility index of the base transportation network, then adding each of the seven routes one-by-one to that network and finding the accessibility index for each added route. Similar to subtraction, the difference between the two was the impact of that route. Staff found only marginal differences between the two methods of measurement and they are used interchangeably here.

One of the major tests of these seven routes involved "through-routing." Through-routing eliminated the transfer between those series of routes that were geographically continuous. For example, a route was formed by the US 29 alignment, Georgetown Branch, and the Bethesda-Tysons Corner alignment. Such a route would require the same transit technology being used on all three components of the route, thus eliminating the need for a transfer when moving from one component to the next. The through-routes evaluated are shown on Map B-3. The existence of through-routing substantially improved demand of some routes. This is discussed in more detail in the discussion of the transitway alignments in Section 2 as well as in the discussion of the transitway network performance in Section 4.

Transfer penalties were assessed when moving between routes, such as at White Oak from the US 29 alignment to the Grosvenor-White Oak alignment. The same was also done for transfers between modes, such as at Silver Spring from the Metrorail Red line to the US 29 alignment.

The "Seven Routes" round of evaluation demonstrated the value of combining some of the alignments with previously master-planned facilities. All of the alignments were carried forward into the next phase of the evaluation. Each of the seven alignments surviving the segments and junctions evaluation continued to demonstrate sufficient demand in this evaluation process to warrant continued consideration. Also, through this evaluation process, some alignments continued to be stronger than others in the top seven.

MAP B.2



RECOMMENDED TRANSITWAY NETWORK

Recommendations

TRANSITWAY TO BE STUDIED BY PLANNING DEPARTMENT

TRANSITWAY TO BE STUDIED BY OTHER AGENCIES

OPERATIONAL IMPROVEMENTS TO BUS SERVICE

Background Transitways

	Existing	Planned
METRORAIL		
MARC AND VIRGINIA RAIL EXPRESS		
TRANSITWAY		

NORTH

9,000 0 9,000 18,000

1 0 1 2 3

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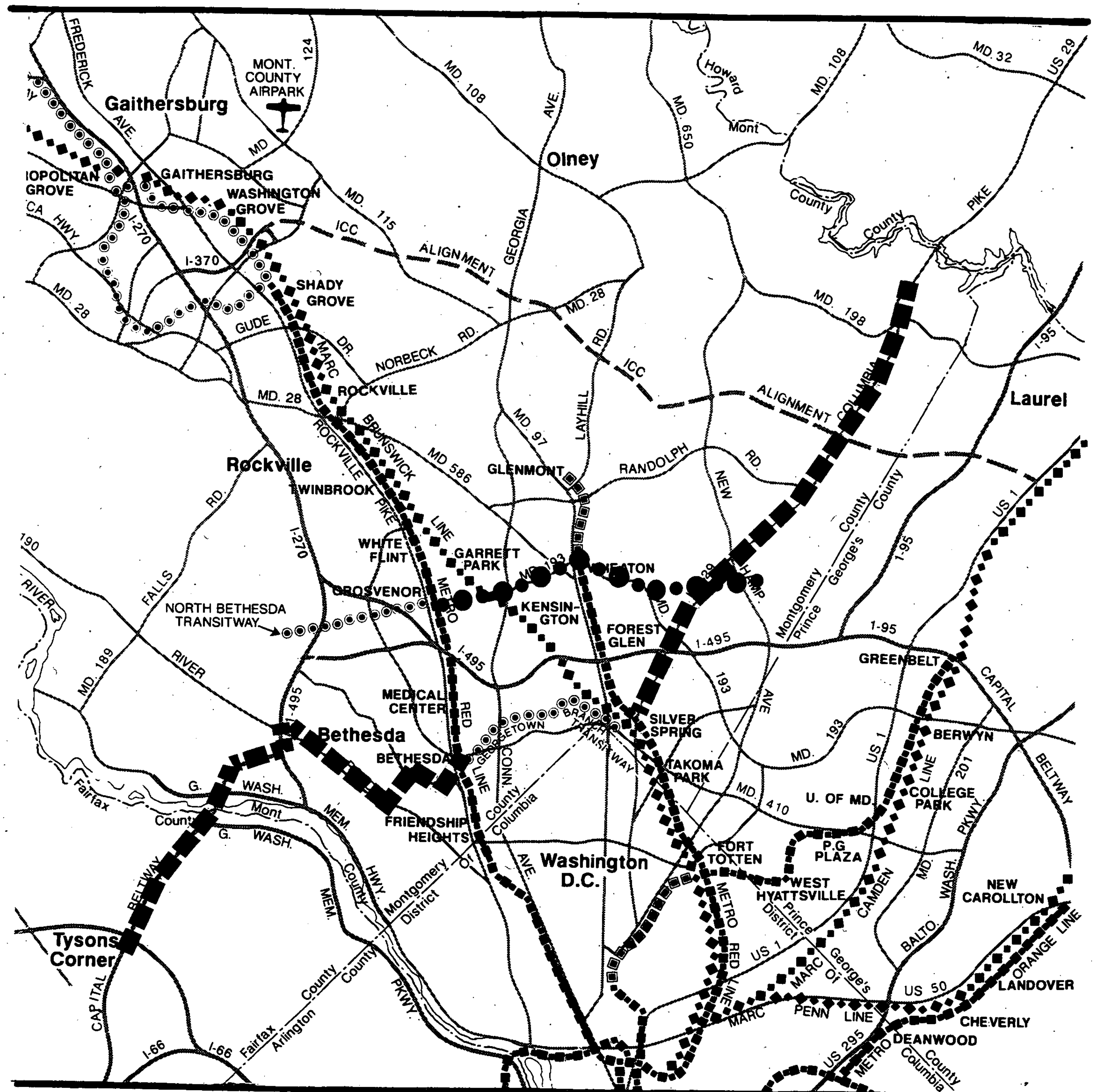
TRANSITWAY AND HOV NETWORK MASTER PLAN

MAP B-3



THROUGH-ROUTES

ALIGNMENT EVALUATED WITH THROUGH-ROUTING WITH NORTH BETHESDA TRANSITWAY

ALIGNMENT EVALUATED WITH THROUGH-ROUTING TO GEORGETOWN BRANCH TRANSITWAY

Background Transitways

	Existing	Planned
METRORAIL		
MARC AND VIRGINIA RAIL EXPRESS		
TRANSITWAY		

NORTH

9,000 0 9,000 18,000

1 0 1 2 3

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TRANSITWAY AND HOV NETWORK MASTER PLAN

Mode Specific Routes

The previous two phases of this analysis dealt with a "Mode X" and measured a transit demand that was non-mode specific. Every Mode X vehicle had a certain speed and headway. To determine the composition of the two separate transitway networks — one light rail and the other busway — the different operating characteristics of the transit vehicles were modeled. In addition, certain characteristics of each alignment were changed to reflect the differences in mode. These changes included:

- **Location of transit stations:** Stations were placed along the remaining alignments in strategic locations adjacent to residential and employment centers, park-and-ride lots, and at other transit stations. Since busways and light rail lines serve somewhat different purposes, an alignment evaluated as a light rail line often had more stations than as a busway.

- **Feeder Bus Service:** With the assistance of the Montgomery County Department of Transportation (MCDOT), two sets of routes were developed for each alignment: one considering the alignment as a busway, a second as light rail. These modified bus routes were used in the appropriate tests.

- **Density around station:** Surveys and data from around the United States show that people will walk farther to a light rail stop than they will a bus stop. Light rail transit is perceived as permanent and people can locate themselves near it with the knowledge that the physical rails cannot be re-routed without much effort. Therefore, staff computed the number of individual residences and jobs within one-quarter mile of each light rail station to more accurately model the number of people who could walk to the station. A higher average ridership is anticipated from those within one-quarter mile walking distance and this is reflected in the demand for rail transit service.

With these modifications, each alignment was then evaluated as both a light rail line and as a busway in much the same fashion as previous steps. That is, the accessibility index for the network including all the alignments was calculated, then each alignment was removed individually from this network and its effect on the network calculated by determining the accessibility index after it was removed. The effects on the anticipated usage of other transit modes (Metrorail, MARC, etc.) was also calculated.

C. Transitway Planning Considerations

Several issues not covered elsewhere regarding transitway planning are discussed here. These include:

- station location,
- the role of different types of transit,
- safety,
- station design,
- station access,
- location of maintenance, storage, and inspection areas, and
- light rail in mixed traffic.

Station Location

The regional transportation model used in these evaluations does not possess the fine-grained detail necessary for station location. Such detail includes:

- smaller traffic zones (the size of a city block, for instance),
- sidewalk existence and quality,
- parking capacity, and
- station size.

Therefore, the locations of the stations listed for the alignments recommended for further study as transitways are not binding on future studies. As noted in the listing of the stations, they were chosen for reasons primarily outside the model: proximity to a dense residential development or for a connection to a Metrorail station, for example. However, if future studies reveal locations that can provide similar accessibility with fewer community and/or environmental impacts, they can and should be used.

The Role of Transitways

Transitways can be used for several different purposes. For instance, commuter rail provides line-haul, or long distance, service; heavy rail can provide frequent and high-capacity service, but long distance lines are hampered by fiscal constraints; light rail has the flexibility to provide both line-haul and local services, but its frequency is often not sufficient to provide the high capacity service heavy rail does.

Transitway planning must take these attributes into account, complementing them if possible. Providing connections to commuter rail and Metrorail services can enhance mobility and builds on the existing major public investment in and familiarity with these services.

Safety

Vehicular and pedestrian safety is of paramount importance in the design of the locations where the paths of movement cross each other at-grade throughout the network. Design of the alignments and safety concerns, particularly directed toward reducing the potential for accidents, will be considered during the continuing development of this Master Plan. Engineering criteria such as grade, radius of curvature, and speed will be taken into account in the feasibility study and detailed right-of-way delineation of the alignments done during the development of the Staff Draft Master Plan. Guidelines will also be assembled to identify safety considerations and the necessary actions to increase safety.

Station Design

Stations need to be designed to facilitate transit transfers and the movement of passengers between the transit service and the means by which they arrive at or leave the station. The interconnection of pedestrian, bicycle, auto drop-off (or kiss-and-ride) areas, parking, and bus and/or other transit services to the station is considered both in planning the location and designing the layout of the stations.

Station Access Locations

Similar to the location of the station, the access to the station is important as well. If it is poorly designed, the effects of the station on local circulating traffic can be harmful. There are distinct differences between HOV and transitway facilities that need to be taken into account when choosing mode type. For example, HOV facilities will attract only buses, vans, and cars; pedestrians, bicyclists, feeder buses, and cars will travel to a transit station or stop.

Also, the mix and intensity of land uses in the vicinity of the transit stations will create different levels of activity. A stop in an area of predominantly residential land uses, for example, will have a different level of activity than one in a mixed-use center.

Locations of Maintenance, Storage, and Inspection Areas

Transit services require locations to store, inspect, and repair transit vehicles. In the case of rail vehicles, the location of this light industrial activity should be adjacent to the transit line and will be most efficient if located at or near one end of the line. Ideally, sites should be located either in an area of similar light industrial

use or on sites that are large enough to include buffers to the surrounding area from the noise an visual impact of the activities within.

Both Ride-On and Metrobus buses presently have such service areas, although if a busway is constructed these areas may either need to be expanded to accommodate the additional buses or new areas will need to be constructed.

Effectiveness/Appropriateness of Light Rail Transit in Mixed Traffic

Because the recommended alignments are located in well-developed portions of the County, the rail alignments may well operate in mixed traffic in as much as the alignment may be used by turning vehicles. (Appendix I discusses issues related to light rail transit in further depth.) A local example of this type of light rail technology is in downtown Baltimore where the tracks of the Central Light Rail are embedded directly in Howard Street. Except for buses and emergency vehicles, motorized traffic is restricted from using the area of the tracks except for crossing and turning movements, although pedestrians can walk over the tracks with no obstruction at all.

D. Network Connections to Other Jurisdictions

Several of the recommended alignments provide connections to other jurisdictions. The characteristics of these areas are briefly described below.

Tysons Corner

Tysons Corner is located in Fairfax County, Virginia, at the intersection of the Capital Beltway (I-495), Leesburg Pike (Route 7), Dolley Madison/Chain Bridge Road (Route 123), and the Dulles Airport Access Road. It is known as Fairfax County's "Downtown" due the concentration of office space (20.5 million square feet, 30% of that in the County), the 70,000 mostly white collar jobs in the 1700-acre area, and the vast retail opportunities available in the two regional malls. Tysons is also widely and pejoratively known as the result of suburban planning focused almost entirely on roadways, ensuring that pedestrian and transit access be almost non-existent.

However, the most recent planning effort in Tysons Corner, the *Tysons Corner Urban Center Plan* adopted in mid-1994, foresees a much tighter structure for the area. It proposes a sweeping re-organization of building setbacks designed to encourage pedestrian access, residential and mixed-use development fashioned to bring residents closer to jobs in Tysons, and area-wide support for future heavy or light rail transit. Transit planning has been conducted in conjunction with the Dulles

Corridor Task Force Preliminary Report released in February 1994. In it, land use impacts of three separate transit approaches around eight possible transit stations, including three in Tysons Corner, are examined.

These changes around Tysons Corner and in the Dulles Airport Access Corridor strongly support the recommended alignment from the Bethesda Metro station to Tysons Corner. Future project planning studies will be able to determine and quantify the extent of this support.

Columbia and Howard County

Columbia is between the central cities of Baltimore and the District of Columbia, though closer to Baltimore. Today, a number of Columbia residents use US 29 to travel to employment centers such as Silver Spring and Washington as well as large employers along US 29 such as the Wall Street Journal and Bell Atlantic. Howard County's position on US 29 may change as a result of its current study of medium- and long-range transit options.

Additional Regional Connections

Because the alignments of the Network Master Plan support and are supported by various Metrorail and MARC stations, they also tap into all the areas served by the Metrorail and MARC systems. With the recommended transit network, someone who lives in White Oak can not only travel to the Silver Spring employment center, but also those of downtown Washington, D.C. via Metrorail, and the Gaithersburg/Germantown area via MARC.

E. Questions About the Transit Evaluation Process

There are a number of fundamental questions that should be understood while reading the recommendations of this Report. The position of the Alternatives Report in response to these questions underscores the care taken to examine and explain every assumption as well as its recognition of the effects of its recommendations. The questions are:

- Why didn't the Alternatives Report forecast transit demand for the year 2010 and not further into the future?

- Why doesn't the Alternatives Report concentrate more on providing areas of future development with transit service to encourage more efficient development?

- Why didn't the Alternatives Report capture in its analysis possible changes to future transit or auto pricing?

Options for Timeframe Analysis

While the US Department of Transportation has set a forecasting guideline of 20-25 years for project planning studies that hope to receive federal funding for construction, this Master Plan is not such a study and is not forced to conform to those standards. So the question may be asked: Since the evaluation in the Alternatives Report was not so constrained and could have projected forecasts further in the future — 30, 40, even 50 years from now — why wasn't this option tested?

Forecasts based on these extended timeframes possess successively less and less meaning because their accuracy can rightly be called into question. Problems inherent in long-range forecasts include:

1) Hindsight has not been supportive of long-range forecasts. Who could have predicted 35 years ago — 1960 — that gasoline would cost over a dollar a gallon, that cars would be built getting over 50 miles per gallon, that computers would make it possible for people to work at home, that mobile communications technology would become so integrated into society, and countless other technological and social changes? Who could have imagined in 1954 what the Washington region would be like 40 years hence?

Far too many changes that can have profound effects on travel behavior are unknown. The region in 1954 had no Beltway, no I-270, no suburban communities 20 miles away from the edge of the District which itself was still what some considered a "sleepy southern town." With this in mind, project 25 years into the future: by the year 2020, there may be more single-person households; couples may marry younger but wait to have children until their mid-thirties; the obligatory retirement age may be 75; more people may telecommute; computerized traffic controls may become commonplace; more people may work at night, and so on. Any of these changes could have profound effects on the use of the transportation network, but accurately predicting them is impossible. Perhaps the world will not change as much as it has in the past, but there are no signs the rate of change is diminishing.

2) Land use patterns for over 25 years into the future have not gone through the same regional approval process. While the Round 5 land use forecasts for the year 2020 were approved by the Metropolitan Washington Council of Governments (MWCOG) in early 1994, the analysis of the Alternatives Report was nearly complete and had been based on the Round 4.1 forecasts for the year 2010. The Round 5 forecasts project a slightly slower growth rate for employment and households, and a higher growth rate for population, than Round 4.1. The rough correspondence for households and employment is that Round 5 projects growth levels about five years later than Round 4.1. It is doubtful that such small differences between the two forecasts would change the recommendations of this Report.

In addition, there is the issue of Montgomery County's place in the region. Even if the land use within Montgomery County could be reliably predicted by this agency, the County's strong regional connections would make it impossible to state with any certainty the amount of travel into and out of the County. If the Alternatives Report analyses had been done using land use estimates for the region that had not been accepted by the appropriate regional planning agencies, critics of their results could focus on that data, declaring any results from that process invalid as it would be "fruit of a poisoned tree."

Focus on Future or Existing Development

The Issues Report touched on a possible conflict in planning objectives: whether to plan transit where demand currently exists or at areas that will be developed in the future. There are, of course, arguments for and against each strategy.

If the former approach is taken, areas will develop in the County that will have few alternatives to single-occupant travel for many years; with the latter, the areas of the County most densely populated (both now and in the future) will become even more congested without improved transit and HOV options.

Concentrating resources on the more developed areas, primarily down-county, depends on a population and employment base that already exists rather than one whose development depends more on unforeseen economic turns. But providing transit and HOV alternatives to areas of future development as housing and employment opportunities emerge does not require those living and working there to modify their travel behavior as much. This second approach might even encourage development conducive to transit around stations rather than rezoning and retrofitting existing areas if the same effect is desired.

Fortunately, the two approaches do not have to be mutually exclusive. Indeed, with proper coordination the two approaches can complement one another. This mutual support is what the Alternatives Report hopes to achieve with the recommended networks, working in tandem with the master-planned transitways. The bulk of the recommended alignments are down-county, but they provide connections to important centers that are accessible to up-county residents and employers via existing and master-planned transitways.

Applicability of Pricing Policy Changes

Long-range studies often base their recommendations on scenarios that include increased parking charges and higher gasoline prices. Both of these changes would increase anticipated transit usage.

While this Master Plan is a long-range study, it did not take into account any such changes when forming its recommendations. The reasoning for this is simple

and straightforward: if the pricing policy changes did not occur as assumed, the results gained from any evaluation with those assumptions would come into question. Therefore, this analysis kept the relationship between the cost of driving and the cost of transit stable at 1990 levels for forecasting 2010 demand.

The argument can be made that, since one assumption is as valid, or invalid, as any other, this Master Plan could have tested and based its recommendations on a number of different scenarios. The evaluation results, such as accessibility or demand, could then be presented as a bounded range of values with the lower bound being the set of pricing policies least favorable to transit and the upper bound constituting those found most favorable.

The problem with such a range is that it would more than likely be so broad as to be meaningless: the difference between a scenario that involves halving parking charges and doubling transit fares and a scenario that doubles parking charges and halves transit fares would probably be quite large. Having such a wide range for each alignment would undermine the purpose of the evaluation results by making the distinction between alignments more muddled.

In addition, such ranges would work to the advantage of groups both for and against transit and/or HOV facilities: those opposed to transit could easily point to the lower bound and claim the community impacts are not worth such a small amount of potential demand while those supporting transit could reference the higher bound and state that the recommended network did not go far enough since so much demand is being served by one facility.

APPENDIX C

HOV

EVALUATION

PROCESS

Appendix C

HOV Evaluation Process

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Maps

Tables

Appendix C HOV Evaluation Process

High-occupancy vehicle (HOV) facilities were considered in several different ways. First, long-haul HOV facilities were evaluated. Next, staff tested a number of spur HOV lanes. These are intended to provide a continuous HOV connection between major (long-haul) HOV facilities, such as the Capital Beltway (I-495), to large activity centers, such as the Bethesda CBD. Finally, the potential of being a shared bus/HOV facility was evaluated.

A. HOV Measures of Evaluation

As mentioned in Appendix A, there were several measures of evaluation specific to each mode. Recommendations of HOV facilities were based on several factors. A discussion of these factors is presented here.

Person Volume

A crucial test of an HOV facility is whether it carries more people than either the non-HOV facility or the parallel general use lanes. If an HOV lane fails this test, it has no potential of becoming an HOV facility since the sole purpose of HOV restrictions is to move more people as opposed to moving more vehicles.

HOV Accessibility

Appendix A described the general workings of accessibility as a measurement. County-wide accessibility is broken up into three modes: single-occupant vehicle (SOV), high-occupancy vehicle (HOV), and transit. The index for each mode measures the opportunities available by that mode. SOV accessibility encompasses every opportunity available, since every developed parcel in the County is required to be reachable by the auto. HOV accessibility exists even when there are no HOV facilities — carpools are still formed without HOV facilities. The addition of HOV facilities that provide a time savings will supply more opportunities for carpools, thus increasing the accessibility index for HOVs.

Whether a lane is added or optimized for HOV restrictions can significantly influence its effect on County-wide mobility. Adding a lane entails the construction of an entirely new lane for use by HOVs only during all or portions of a day.

Optimizing a lane restricts the use of an existing lane to HOVs during all or portions of a day. Adding a lane increases capacity and nearly always increases accessibility. In most cases, optimizing a lane will decrease capacity and thus decrease accessibility. Therefore, when a lane is optimized but accessibility still increases, as is the case with one of the recommended alignments, the County-wide time savings for HOVs outweighs the County-wide increase in travel time for SOVs. In fewer cases, the SOV accessibility can increase along with the HOV accessibility. This indicates that the HOV lane is successful enough to remove a sufficient number of cars from the road to quicken SOV travel as well.

Vehicle Speed

If the difference in speed between an HOV lane and parallel general use lanes is not substantial, very few users will be persuaded to use the HOV facility since little time savings is provided. This generally indicates one of two conditions:

- The corridor is not congested enough for HOV to provide any time savings; or
- The HOV facility is as congested as the general use facility, signifying that a change in the HOV restrictions is necessary.

Vehicle Volume

Vehicle volume measures the number of vehicles on the HOV lane(s) in the peak hour. While this measure is important, the number of people being moved on an HOV facility is more noteworthy since an HOV lane often carries fewer vehicles while moving more people.

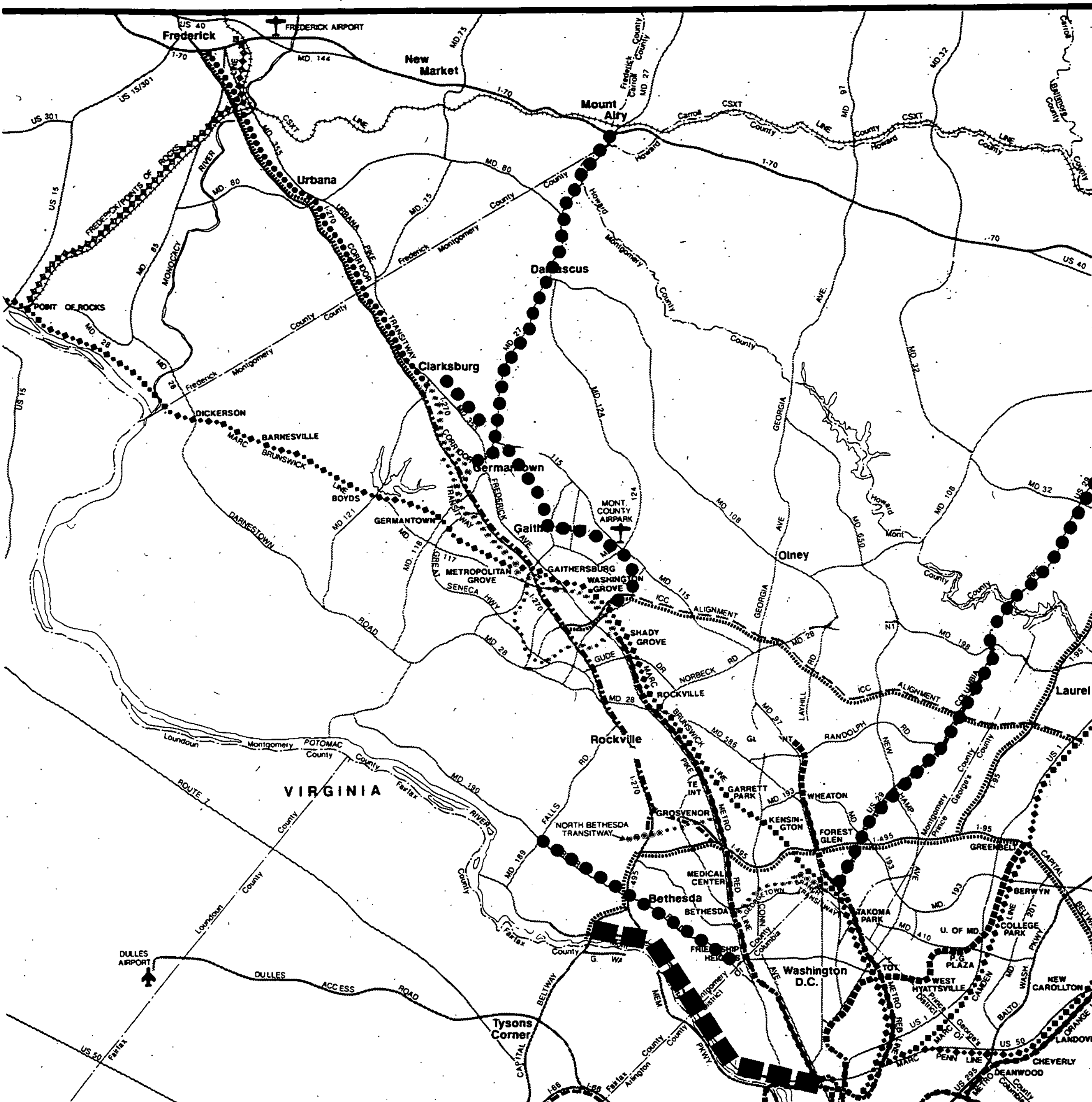
HOV Measures of Success

Appendix D reviews several non-quantitative measures that were also used in the evaluation process.

B. Evaluation of Long-Haul HOV Facilities

As seen in Table C-1 and Map C-1, five of the 19 proposed alignments were identified by staff as being potentially suitable for long-haul HOV lanes. Such lanes, as the name implies, are often several miles in length and provide time savings over that entire length.

MAP C-1



LONG HAUL HOV

ALIGNMENT RECOMMENDED FOR FURTHER STUDY AREA

ALIGNMENT EVALUATED BUT NOT RECOMMENDED FOR FUTHER STUDY

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			

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In addition, several other alignments are being considered by other agencies for HOV lanes. Some are the subject of current State project planning studies while others are being considered by the State for future study:

- the Capital Beltway (I-495) in Maryland,
- I-95 from the Capital Beltway (I-495) to the Baltimore Beltway (I-695),
- the Intercounty Connector (ICC).

These facilities were included in the HOV analysis, as was the I-270 HOV facility currently being implemented by the State Highway Administration (SHA). The full HOV network consisted of these facilities plus the five alignments to be evaluated.

Using the base transportation network plus the other facilities listed above as a constant, staff conducted model analyses to assign independent measures of accessibility for each alignment. First, the characteristics of each facility needed to be established. As discussed in Appendix H, there are different ways HOV facilities can be set up. They can either add or optimize a lane. "Add-a-lane" entails the construction of an entirely new lane or lanes, while "optimize-a-lane" increases the minimum person-carrying volume of a general-use lane by imposing restrictions on occupancy for those who use it. The characteristics of the five HOV alignments evaluated here are described in Table C-1.

Table C-1
Operational Characteristics of Evaluated Long-haul HOV Facilities

Facility	Length (miles)	Existing Lanes	Peak Direction Lanes		Off-Peak Direction Lanes		Add or Optimize?
			HOV	General Use	HOV	General Use	
Clara Barton Parkway/Cabin John Parkway							
Georgetown-Chain Bridge	4.9	2	2	0	0	0	Optimize
Chain Bridge-Beltway	2.5	1	1	0	0	0	Optimize
US 29							
Beltway-New Hampshire	2.5	6	1	2	1	2	Optimize
New Hampshire-MD 198	8.2	6	1	3	1	3	Add
Ridge Road (MD 27)	13.5	4	1	2	0	1	Optimize
Midcounty Highway (M-83)	8.2	0	1	1	1	1	Optimize
River Road (MD 190)	3.4	2	1	1	0	1	Add

Each HOV alignment was evaluated separately. First, the accessibility indices for both the base transportation network and the full HOV network were computed as a basis for comparison. Then, each HOV facility was removed from the full HOV network to find its impact on the County-wide HOV system. For example: the HOV facility on River Road was removed from the full HOV network, and accessibility

indices were computed for the remainder of the network that included the other four alignments. In the next evaluation, River Road HOV was inserted back into the network and another alignment was removed, such as the HOV lanes on US 29. A second set of accessibility indices was then computed. In this manner, the contribution of each HOV facility was evaluated independently. By comparing the resulting indices to those for the full network, the relative contribution each individual facility would make to the overall accessibility of the network could be assessed.

In the second stage of analysis, the HOV alignments that contributed most to overall mobility were modeled together so that the contribution of the multiple alignments could be evaluated. HOV alignments that did not contribute significantly to the overall accessibility of the County were eliminated from further consideration during this stage. It is important to note that even though some alignments did not prove useful as HOV lanes, all appropriate alignments were evaluated in the transitway network analyses.

C. Spur HOV Facilities

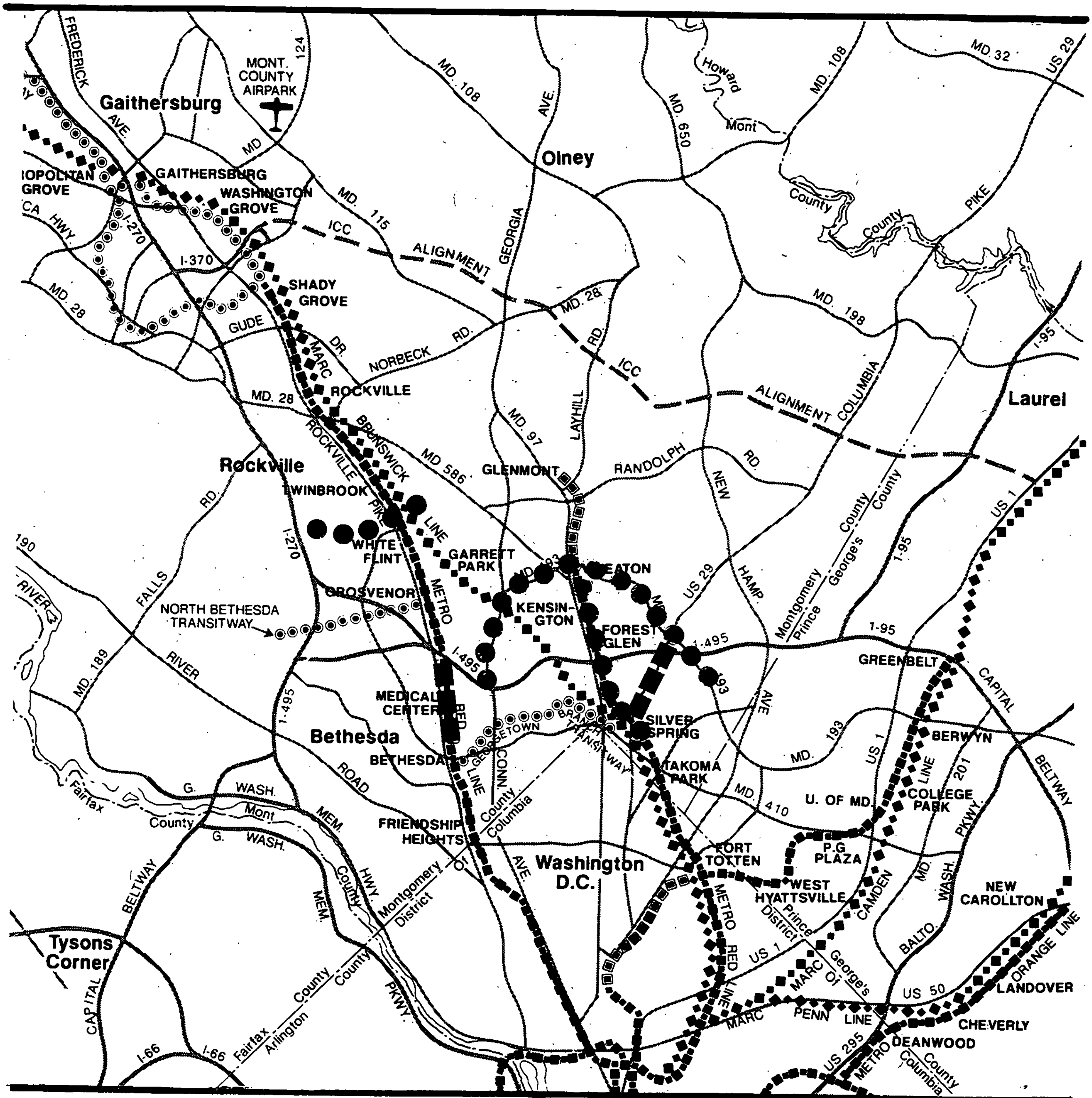
Staff recognized that short HOV links between major HOV facilities, such as the Capital Beltway (I-495), and major activity centers, such as the Silver Spring and Bethesda CBDs, could create significant time savings. The HOV links would enable commuters to drive more quickly along the congested major roadways and through congested intersections.

The seven links identified as potentially providing such time savings are listed, along with their operational characteristics, in Table C-2. They are also shown on Map C-2. The main difference between evaluating spur and long-haul HOV lanes is that accessibility increases could not be reliably computed for the spur HOV lanes.

D. Shared Busway/HOV Facilities

Two alignments — Georgia Avenue and US 29 — were considered for evaluation as shared busway/HOV facilities. However, operational difficulties of such a facility were thought to be too difficult to overcome. Therefore, they were not tested.

MAP C-2



SPUR HOV

Recommendations

ALIGNMENT RECOMMENDED FOR FUTHER STUDY

ALIGNMENT EVALUATED BUT NOT RECOMMENDED FOR FURTHER STUDY

Background Transitways

	Existing	Planned
METRORAIL		
MARC AND VIRGINIA RAIL EXPRESS		
TRANSITWAY		

NORTH

9,000 0 9,000 18,00

1 0 1 2 3

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Table C-2
Spur HOV Facilities Evaluated

Roadway	Length (miles)	Existing Lanes	Peak Direction Lanes: HOV	Peak Direction Lanes: General Use	Off-Peak Direction Lanes: HOV	Off-Peak Direction Lanes: General Use	Add or Optimize?
Bethesda CBD							
Wisconsin Avenue: Cedar Lane to Woodmont Avenue	1.5	6	1	3	0	3	Add
Silver Spring CBD							
US 29: Beltway to Spring Street	1.4	6	1	3	0	2	Optimize
Georgia Avenue: Beltway to Spring Street	1.1	7	1	3	0	3	Optimize
Wheaton CBD							
Georgia Avenue: Beltway to University Boulevard	1.5	6	1	2	0	3	Optimize
University Boulevard: Beltway to Georgia Avenue	3.6	6	1	2	0	3	Optimize
Connecticut Avenue/ University Boulevard: Beltway to Georgia Avenue	3.4	6	1	2	0	3	Optimize
North Bethesda							
Montrose Parkway: Montrose Road to Parklawn Drive	2.6	0	1	1	1	1	Optimize

E. HOV Planning Considerations

Several issues not covered by the quantitative evaluation process were also considered when evaluating HOV alignments. For instance, staff was averse to putting an HOV facility on an arterial roadway for several reasons, primary among them the difficulty in enforcement. A more detailed explanation of HOV facilities and these issues is found in Appendix H.

HOV Occupancy Levels

When questions are raised about HOV lanes, one of the foremost in commuters' minds is the occupancy level. The objective of an HOV lane is to move more people in fewer cars, and the minimum occupancy level for HOVs varies on

facilities throughout the country, although the predominant level is HOV 2+. Each HOV alignment in the Alternatives Report was evaluated as HOV 2+.

HOV 2+ is the lowest occupancy requirement possible, and there is the potential that so much demand could be attracted as to make the HOV lanes as congested as the parallel general-use lanes. However, if this same HOV lane's occupancy requirement is raised to HOV 3+, the number of vehicles may be reduced so much that the HOV lane appears nearly empty.

The appearance of such an HOV facility can be interpreted in two ways:

- The absence of congestion on the HOV facility provides a clear incentive to single-occupant travel. Users of the general-use lanes can clearly see that commuters on the HOV facility are not battling traffic congestion to reach their destinations.

- The appearance of an underutilized HOV lane can cause a backlash from commuters who point to the seeming lack of use as a reason to eliminate the occupancy restriction altogether. This may even happen if the HOV lane is moving more people, rather than vehicles, than any general-use lane.

Although it is important to maintain consistency in HOV restrictions, especially when an overall network of HOV lanes is established, this may not always be possible. Careful consideration must be given to the impact of creating either excessive congestion or the appearance of underutilization.

Effectiveness/Appropriateness of HOV Facilities on Roads Other Than Freeways

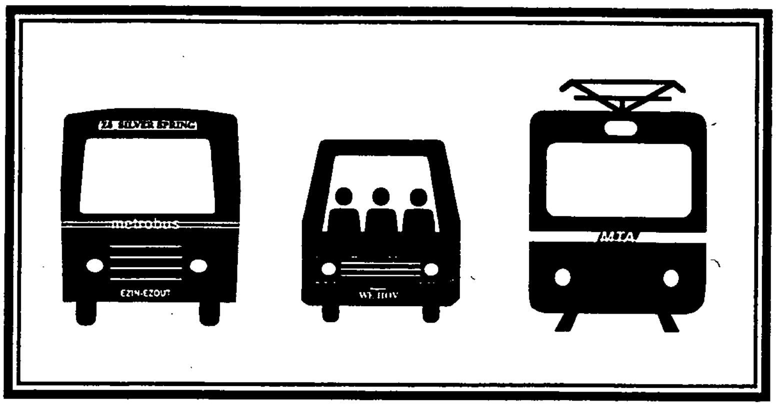
While most HOV facilities in the United States operate on freeways, there are examples of some that exist on arterials. A local example is in Alexandria, Virginia, where HOV 2+ facilities operate on two separate roads in both the morning and evening peak periods.

The difficulty with such facilities lies in their level of land access. While an auto can only enter and exit a freeway at a limited number of points spaced far apart, it can generally enter an arterial at every intersection spaced anywhere from 100 to 1000 feet. This lack of control over access points to and from the HOV facility makes enforcement of the occupancy restrictions extremely difficult.

Because of the difficulty of enforcement and the limited number of successful examples, this evaluation focused initially on limited-access facilities. Short links providing connections to major employment and household centers have subsequently been evaluated.

Connections to Georgetown/Washington, D.C.

During the weekday peak periods, the Clara Barton Parkway/Cabin John Parkway alignment recommended for further study directly serves the employment center of Georgetown, and more indirectly serves the heart of downtown Washington's employment, moving these workers out to the Capital Beltway. These portions of Washington, D.C., are not foreseen to undergo any major modifications that would change the demand forecast for this facility.


SILVER SPRING
metrobus
EZIN-EZOUT
MTA

APPENDIX D

MEASURES

OF

SUCCESS


SILVER SPRING
metrobus
EZIN-EZOUT
MTA

Appendix D Measures of Success

This appendix details the various quantitative and qualitative measures of success staff and the Citizens Advisory Committee devised to evaluate alignment corridors as a supplement to those produced by the TRAVEL/2 transportation model.

Measures of Success for All Three Modes

1. Measurably increasing accessibility to regional employment opportunities for residents of Montgomery County.

2. Measurably increasing regional accessibility to employment in Montgomery County.

3. Reducing energy consumption per traveler.

4. Reducing the amount of parking required at employment centers.

5. Assisting in meeting the requirements of the Clean Air Act Amendments and the Visions of the State Planning Act.

6. Being more beneficial (less harmful) than alternative modes in regard to direct (and indirect) environmental and/or community impacts.

Measures of Success for Light Rail Lines

1. Connecting major centers of activity - especially mixed use centers.

2. Connecting major transit lines and other transit facilities.

3. Increasing total system transit ridership.

4. Reducing capital costs by being able to use existing rights-of-way.

5. Reducing congestion on heavily travelled routes by increasing transit usage as a share of total travel (transit mode share).

6. Improving the tax base by a measurable amount.

7. Increasing economic development potential by meeting the requirements of the Adequate Public Facilities Ordinance.

8. Attracting sufficient ridership to achieve an acceptable level of return on the operating costs, such as 50 percent.

9. Providing service during off-peak times for shopping, recreational activities, cultural events, or visiting friends.

10. Increasing mobility for those who are transit-dependent.

11. Providing a safer mode of travel than non-transit modes.

Measures of Success for High-Occupancy Vehicle Facilities

1. Achieving a time savings of at least 5 minutes per commuting trip.

2. Moving more people in fewer vehicles.

3. Reserving capacity to accommodate future increases in demand by raising the minimum occupancy requirement.

4. Increasing carpool and vanpool usage.

5. Reducing capital costs by being able to use existing lanes and/or rights-of-way.

6. Reducing congestion on roadways by reducing vehicle travel in peak periods.

7. Reducing the state and local contributions to highway projects which include HOV facilities compared to projects which do not include HOV facilities.

Measures of Success for Busways

1. Connecting major centers of activity - especially mixed-use centers.
2. Connecting major transit lines and other transit facilities.
3. Increasing total system transit ridership.
4. Reducing capital costs by being able to use existing rights- of-way.
5. Reducing congestion on roadways by increasing transit usage.
6. Reducing the number of transfers per trip.
7. Improving the tax base by a measurable amount.
8. Attracting sufficient ridership to achieve an acceptable level of return on the operating costs, such as 50 percent.
9. Providing service during off-peak times for shopping, recreational activities, cultural events, or visiting friends.
10. Increasing mobility for those who are transit-dependent.
11. Providing a safer mode of travel than non-transit modes.

Table D-1
Measures of Success Applied to Light Rail Alignments

		Grosvenor-White Oak	US 29	Bethesda-Tysons
	ALL			
1	Improve regional access for MC residents?	Y	Y	Y
2	Improve access to MC employment?	Y	Y	Y
3	Reduce energy consumption?	Y	Y	Y
4	Reduce parking required?	Y	Y	Y
5	Meet CAAA/State Planning Act?	Y	Y	Y
6	Mode has least environmental/ community impact?	--	--	--
	LIGHT RAIL			
1	Connect activity centers?	Y	Y	Y
2	Connect transit lines?	Y	Y	Y
3	Increase total transit use?	--	--	--
4	Use existing r-o-w?	Y	Y	--
5	Improve transit share?	--	--	--
6	Improve tax base?	Y	Y	Y
7	Increase development potential?	Y	Y	Y
8	Ridership provide acceptable return?	--	--	--
9	Provide off-peak service?	Y	Y	Y
10	Increase mobility for transit dependent population?	Y	Y	Y
11	Safer than non-transit modes?	Y	Y	Y

-- : insufficient information at present

Table D-2
Measure of Success Applied to Busway Alignments

		Georgia Avenue	US 29
ALL			
1	Improve regional access for MC residents?	Y	Y
2	Improve access to MC employment?	Y	Y
3	Reduce energy consumption?	Y	Y
4	Reduce parking required?	Y	Y
5	Meet CAAA/State Planning Act?	Y	Y
6	Mode has least environmental/ community impact?	--	--
BUSWAY			
1	Connect activity centers?	N	Y
2	Connect transit lines?	Y	Y
3	Increase total transit use?	Y	Y
4	Use existing r-o-w?	Y	Y
5	Improve transit share?	--	--
6	Reduce transfers?	--	--
7	Improve tax base?	--	--
8	Ridership provide acceptable return?	--	--
9	Provide off-peak service?	Y	Y
10	Increase mobility for transit dependent population?	Y	Y
11	Safer than non-transit modes?	Y	Y

-- : insufficient information at present

Table D-3
Measures of Success Applied to Long-haul HOV Alignments

		Clara Barton/Cabin John Parkway
	ALL	
1	Improve regional access for MC residents?	Y
2	Improve access to MC employment?	N
3	Reduce energy consumption?	Y
4	Reduce parking required?	Y (in D.C.)
5	Meet CAAA/State Planning Act?	Y
6	Mode has least environmental/ community impact?	--
	HOV	
1	Provide 5 minute time savings?	Y
2	Move more people in fewer vehicles?	Y
3	Reserve capacity for future demand?	Y
4	Increase carpooling?	Y
5	Use existing right-of-way?	Y
6	Reduce congestion?	Y
7	Allow greater use of federal funding?	Y

-- : insufficient information at present

APPENDIX E

DESCRIPTION OF THE BACKGROUND TRANSPORTATION NETWORK

Appendix E

Background Transportation Network

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Appendix E Description of the Background Transportation Network

The following transportation facilities and services were included in the background transportation network for the year 2010. The background transportation network in the TRAVEL/2 transportation model consists of facilities present in every scenario tested. For instance, while HOV facilities do not currently exist on I-270 (except for on its east spur), they are in the background of TRAVEL/2 and are used in each of the alternative scenarios tested.

A. Pedestrian and Bicycle Facilities

The existing and master planned pedestrian and bicycle facilities are included in the background transportation network. They are shown on the 1978 Master Plan of Bikeways and on the individual master plans. The background transportation system also includes the trails shown in the 1991 "Guide to Trails" published by The Maryland-National Capital Park and Planning Commission.

B. Roadways

The existing and master-planned highways and roadways are included in the background transportation network. They are shown on the Master Plan of Highways. Regional road changes are listed at the back of this appendix.

C. Existing and Programmed Transit Facilities

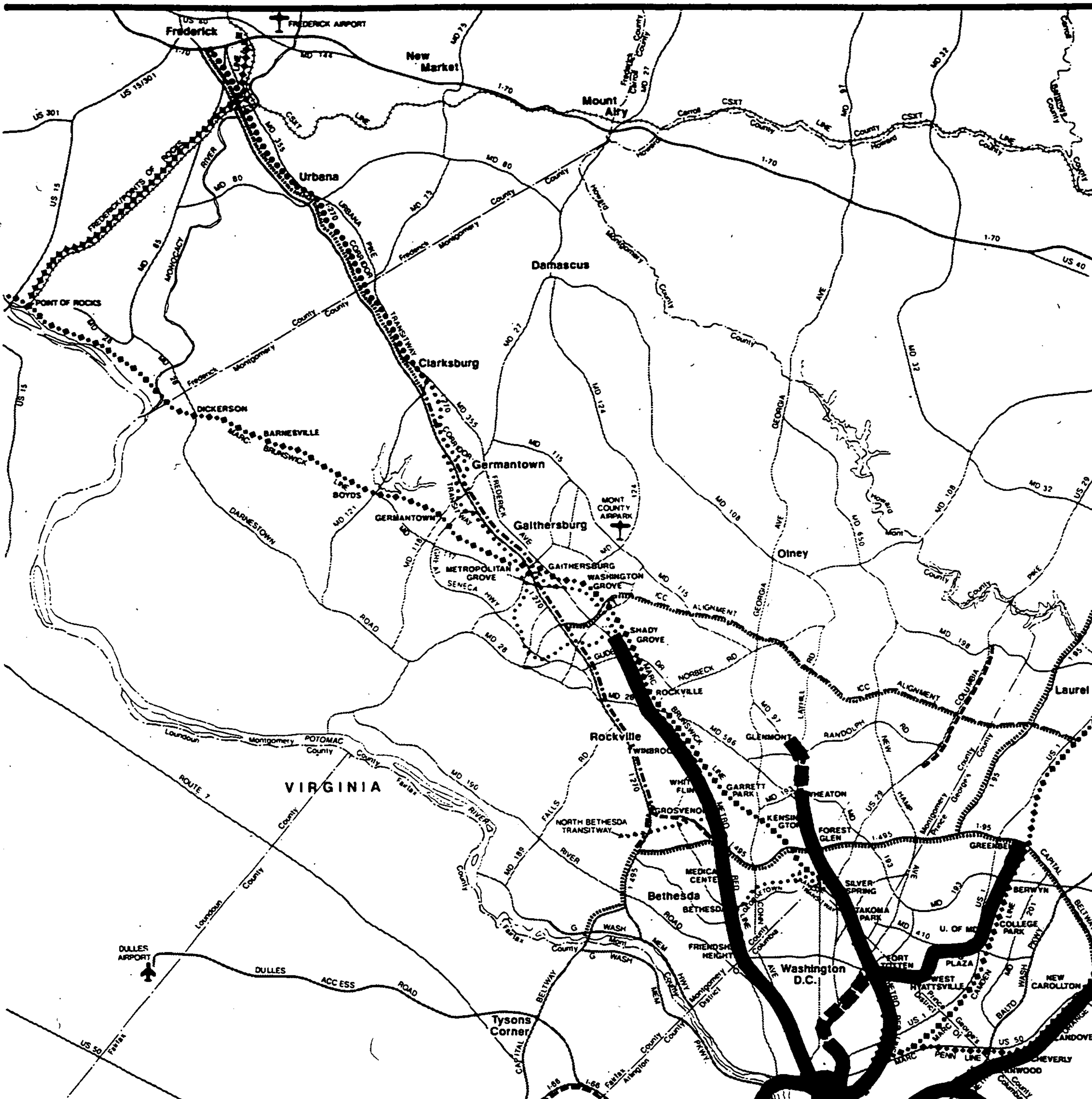
Metrorail (Map E-1)

The full 103-mile Metrorail system is a key part of the future network. The two branches of Metrorail's Red Line serve Montgomery County, the eastern branch extending up Georgia Avenue to Glenmont and the other parallelling Rockville Pike (MD 355) to the Shady Grove station. This service provides connections to the District of Columbia and the rest of the Metrorail network. There are 12 Metrorail stations in Montgomery County, and two of them (Silver Spring and Rockville) provide connections to MARC commuter rail service. At the time of the Alternatives Report, 11 of the 12 stations were operational and the last, Glenmont, is scheduled to open in mid-1998 and is in the background network.

Table E-1
2010 Background Regional Rail Network

	Peak Waiting Time (in minutes)	Off-Peak Waiting Time (in minutes)
Full 103-mile Metrorail System		
Between Silver Spring and Grosvenor	2	2
Remainder of system	4	4
Georgetown Branch Transitway	6	6
North Bethesda Transitway	6	6
Corridor Cities Transitway (Shady Grove/Clarksburg)	10	10
Virginia Railway Express between		
Union Station and Quantico	60	0
Union Station and Manassas Airport	60	0
MARC Service between Union Station and		
Frederick via Point of Rocks	20*	30
Martinsburg	20*	0
Camden Yards	10	20
Penn Station	10	20

* effective headways in Montgomery County would be 10 minutes



METRORAIL FACILITIES

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			
NETWORK OF ALIGNMENT CORRIDORS			

NORTH

9,000 0 9,000 18,000 27,000

1 0 1 2 3 4

TRANSITWAY AND HOV NETWORK MASTER PLAN

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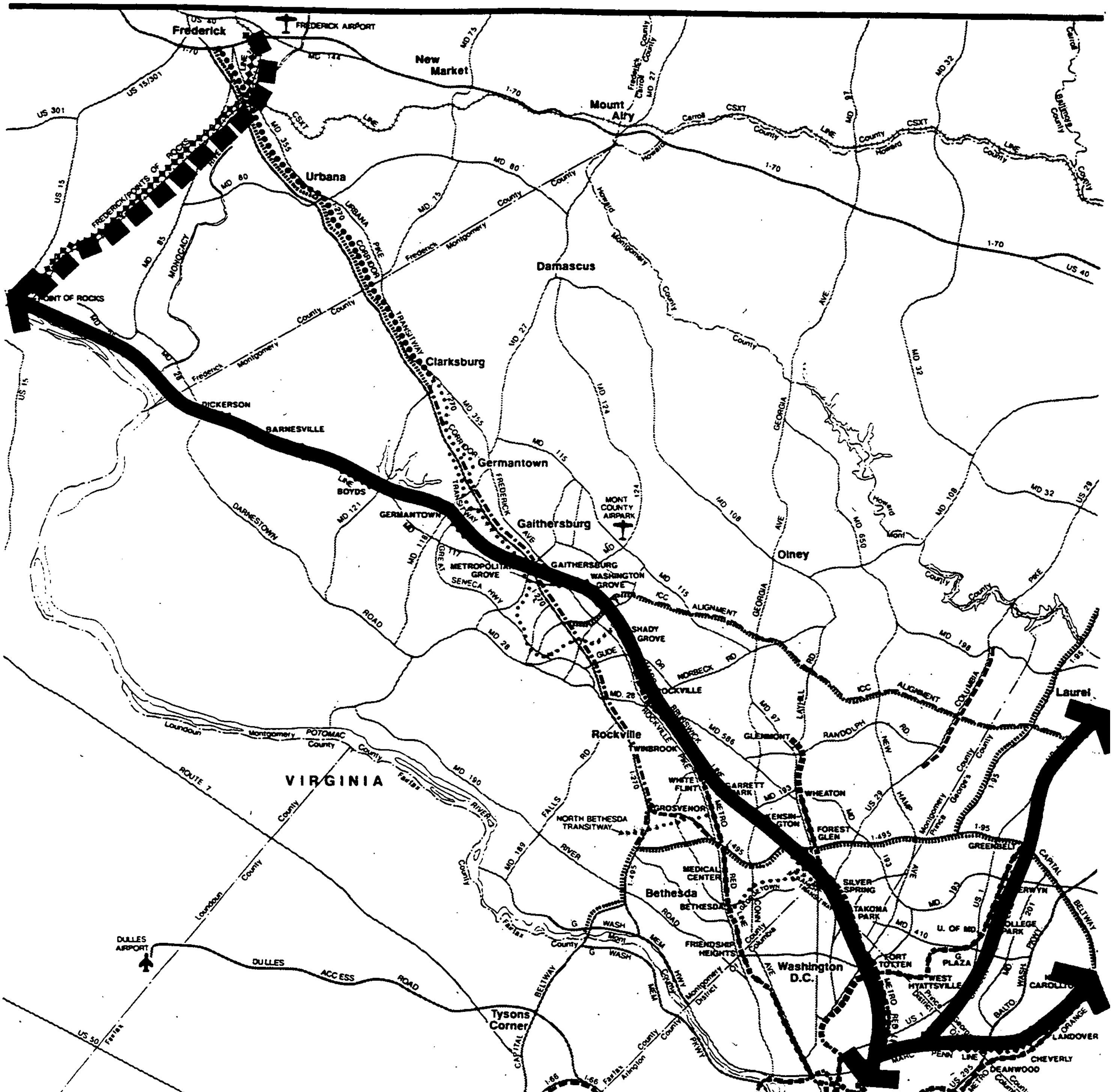
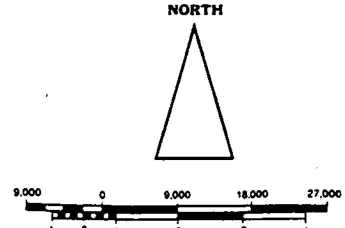
MAP E-2



COMMUTER RAIL FACILITIES

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			

NETWORK OF ALIGNMENT CORRIDORS



TRANSITWAY AND HOV NETWORK MASTER PLAN

The Maryland-National Capital Park and Planning Commission

MARC Commuter Rail (Map E-2)

Montgomery County is served by the Brunswick Line of the Maryland Commuter Rail service (MARC) operated by Maryland's Mass Transit Administration (MTA). This line connects Union Station in Washington, D.C., with Martinsburg, West Virginia. Present MARC service on the Brunswick Line is designed to provide peak direction service for commuters, but service in the model's forecast year of 2010 travels in both directions, although with a shorter headway in the peak direction. There are currently six trains in that serve the 11 stations in Montgomery County. Additional service is currently programmed that will connect Frederick City to the Brunswick line via Point of Rocks. This addition is assumed as background in the TRAVEL/2 model.

Bus Service (Map E-3)

Public bus transit service in Montgomery County is provided by Metrobus and Montgomery County Ride-On service. In addition, private operators provide commuter bus service. Montgomery County is served by routes from MTA (2), Metrobus (23), and Ride-On (66) that serve over 111,000 passengers per day.

Transit Centers and Park-and-Ride Lots (Map E-4)

Transit centers are designed to provide convenient points where bus patrons can transfer from one route to another, or from one mode of travel to another. There are 10 park-and-ride lots provided by Montgomery County Department of Transportation, two of which are at transit centers. The existing transit centers are located at the 12 Metrorail centers and at Montgomery Mall and Lakeforest Mall. Other park-and-ride lots are located adjacent to transportation corridors to provide easy access for commuters.

D. Existing and Programmed HOV Facilities (Map E-5)

US 29

There are directional peak-period bus lanes on the shoulders of US 29 between Burtonsville at US 198 and Industrial Parkway, south of Randolph Road. Since US 29 is one of the corridors being analyzed in the Alternatives Report for a possible HOV or transit facility, no further assumptions were made.

MAP E-3

MAJOR COUNTY-WIDE BUS ROUTES

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			
NETWORK OF ALIGNMENT CORRIDORS			

ROUTES WITH 2000 OR MORE PASSENGERS DAILY

NORTH

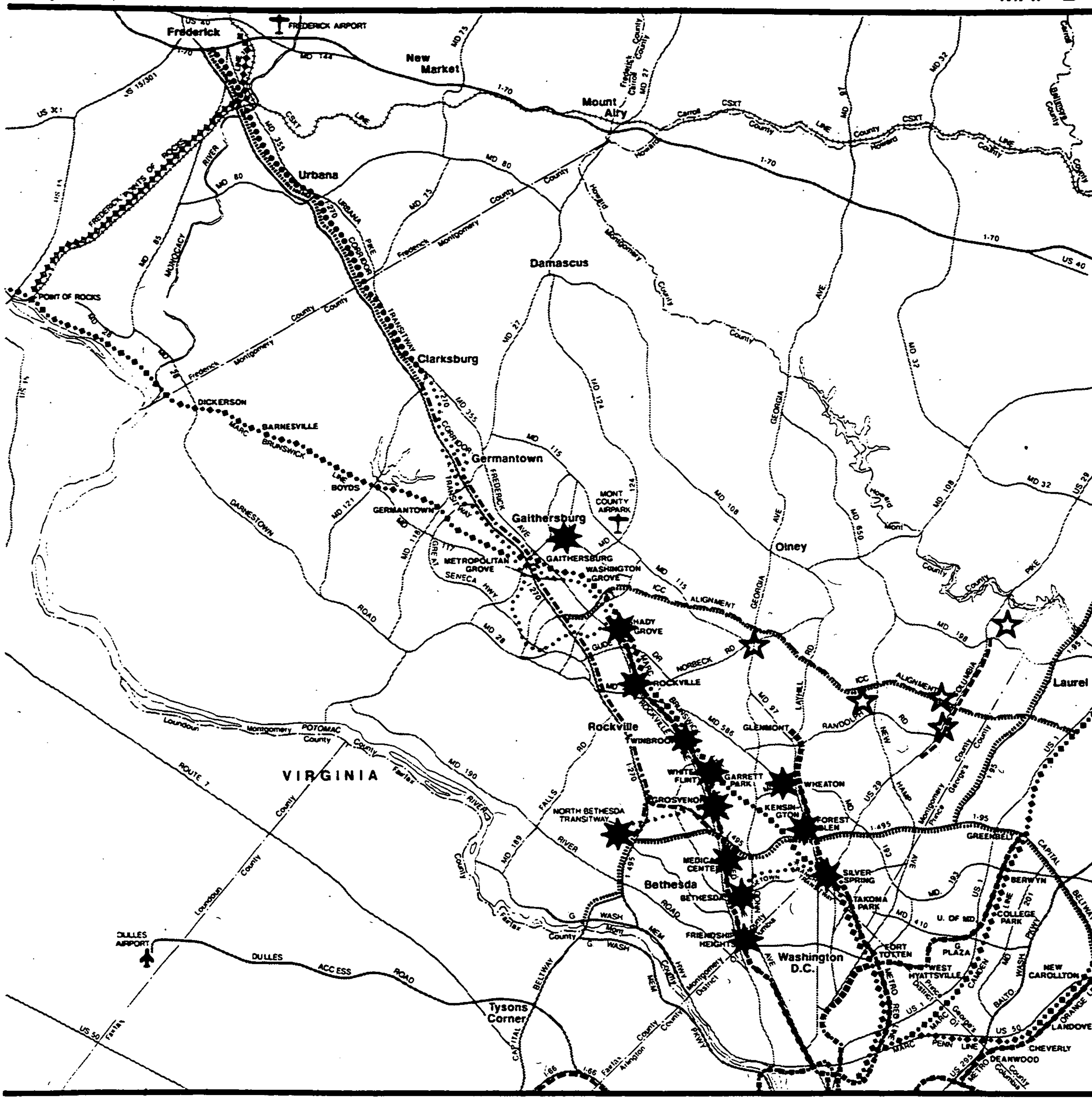
9,000 0 9,000 18,000 27,000

1 0 1 2 3 4

Source: Division of Transit Services, MCDOT

TRANSITWAY AND HOV NETWORK MASTER PLAN

The Maryland-National Capital Park and Planning Commission



TRANSIT CENTERS AND PARK-AND-RIDE LOTS

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			

TRANSIT CENTERS

PARK-AND-RIDE LOTS

NETWORK OF ALIGNMENT CORRIDORS

NORTH

9,000 0 9,000 18,000 27,000

1 0 1 2 3 4

TRANSITWAY AND HOV NETWORK MASTER PLAN

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I-270

When I-270 was widened in the late 1980s, the inside lane in each direction, from the Y-split in North Bethesda north to MD 118, was designated as a future HOV lane. Maryland's State Highway Administration (SHA) currently plans to phase in HOV restrictions (beginning with two or more persons per vehicle) on most of the I-270 mainline by mid-1996. Therefore, one HOV lane in each direction from MD 121 to the Capital Beltway (I-495) is assumed in the model's forecast year of 2010.

E. Ongoing Studies

Capital Beltway (I-495/I-95)

An ongoing Major Investment Study (MIS) will determine the efficacy and feasibility of a variety of transportation options on the Maryland portion of the Capital Beltway. The MIS is being coordinated with a similar effort in Virginia. One of the modal options being investigated is HOV lanes. Others include a light rail line and Transportation System Management. An HOV facility was assumed for the Capital Beltway on the Virginia side, but not for the section in Maryland except where explicitly noted in the HOV evaluations.

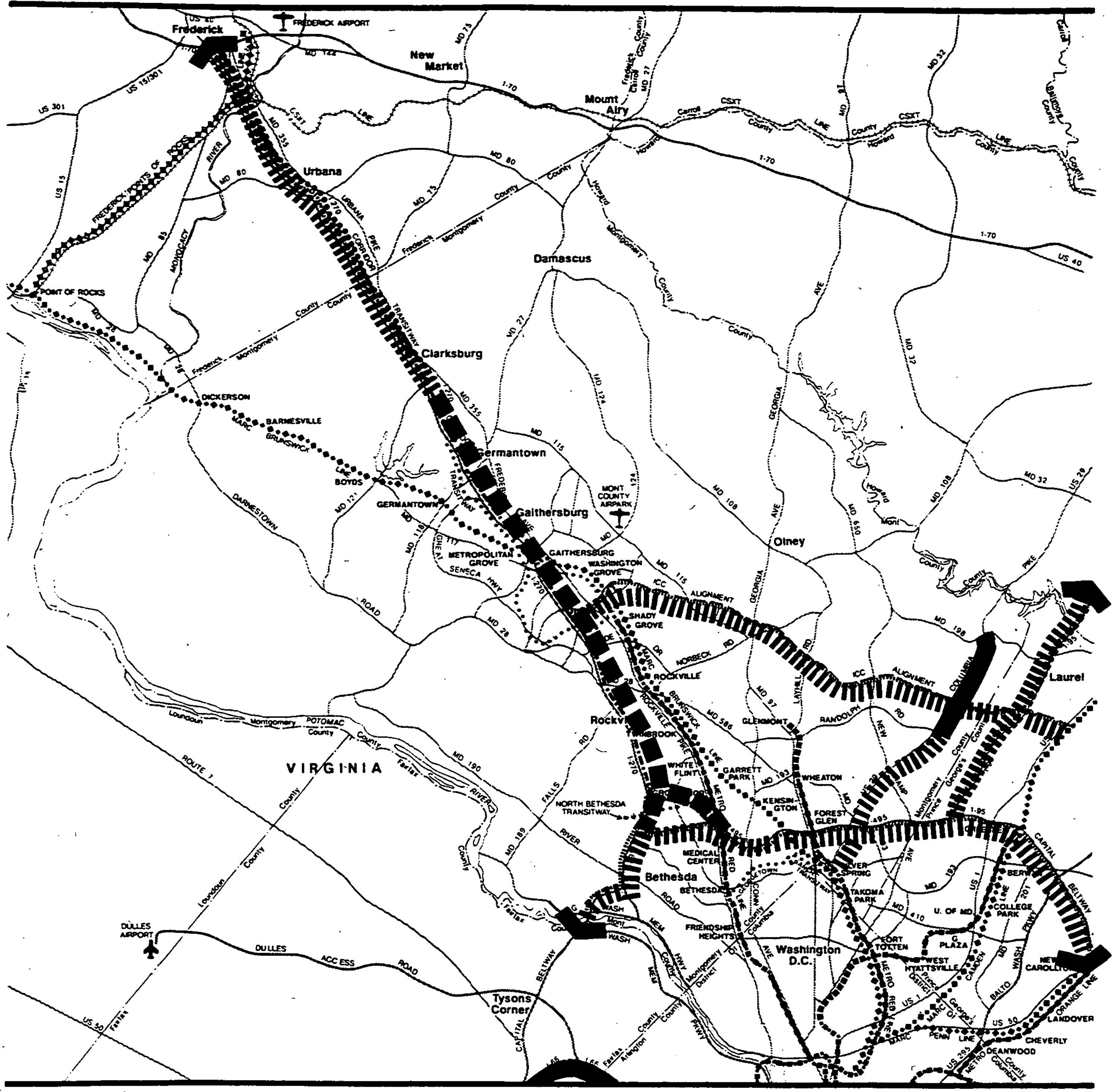
Intercounty Connector (ICC)

This is a major transportation facility that has been on Montgomery County master plans for over 30 years. As proposed, it would connect I-270 (via the already-built I-370) and I-95 in Prince George's County. It is currently the subject of an environmental impact study as part of a project planning study by the Maryland Department of Transportation. The alternative alignments will include consideration of a transitway and HOV facility. It exists in the background network on the master-planned alignment, although the final alignment may change as a result of the ongoing study. The ICC has one HOV lane in each direction in the background network, although no transit facilities besides express buses.

F. Master-planned Transit Facilities

Each of the following transit facilities is included in the background transportation network.

MAP E-5



HOV FACILITIES

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			

NORTH

9,000 0 9,000 18,000 27,000

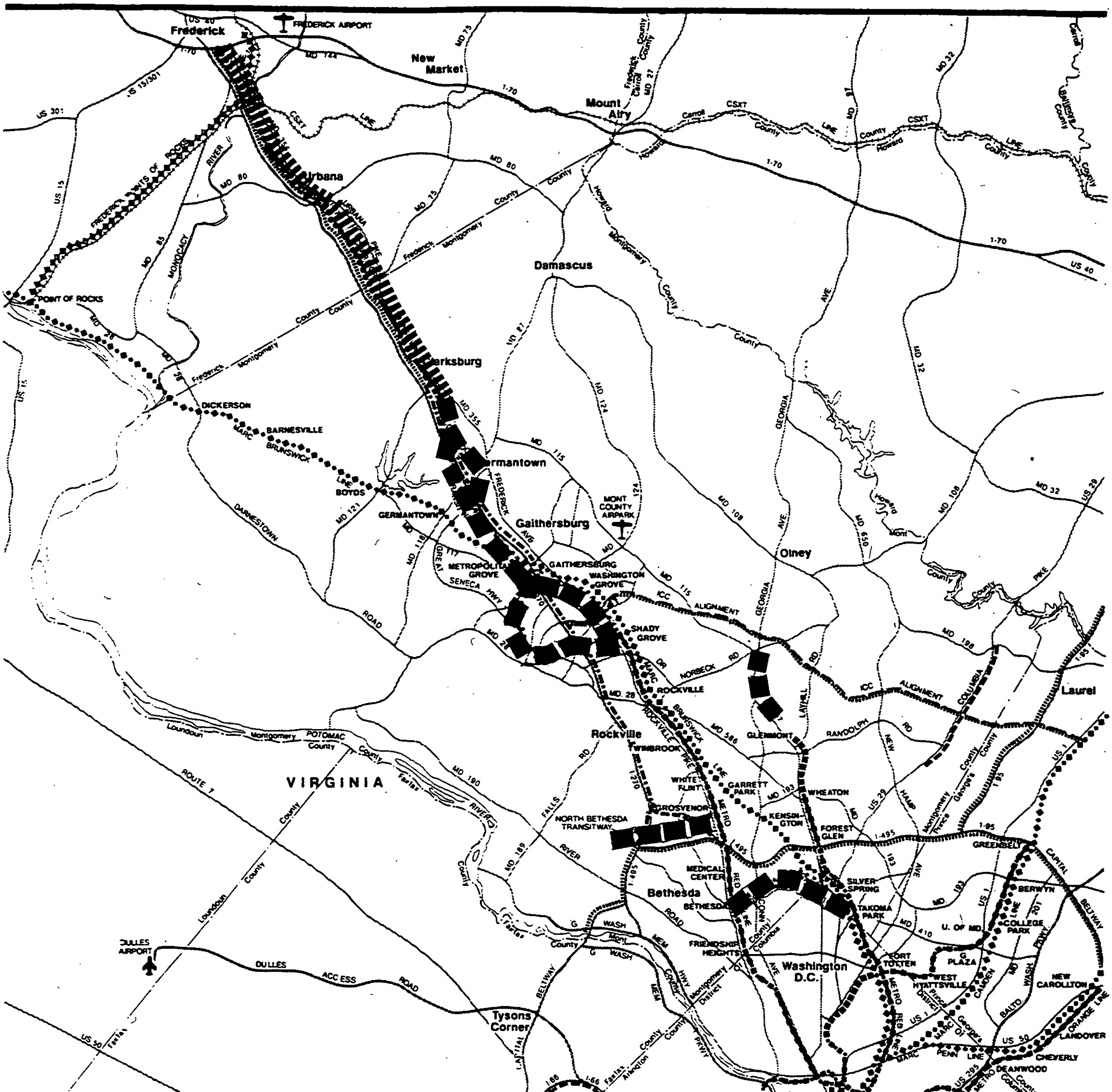
1 0 1 2 3 4

NETWORK OF ALIGNMENT CORRIDORS

TRANSITWAY AND HOV NETWORK MASTER PLAN

The Maryland-National Capital Park and Planning Commission

MAP E-6



TRANSITWAY FACILITIES

	Existing	Planned	Proposed
METRORAIL			
MARC AND VIRGINIA RAIL EXPRESS			
TRANSITWAY			
CSXT AND AMTRAK			
HOV LANES			
NETWORK OF ALIGNMENT CORRIDORS			

NORTH

9,000 0 9,000 18,000 27,000

1 0 1 2 3 4

TRANSITWAY AND HOV NETWORK MASTER PLAN

The Maryland-National Capital Park and Planning Commission

Corridor Cities Transitway

The Corridor Cities Transitway extends north from the Shady Grove Metro station to Clarksburg to Frederick via I-270. There are three alternative alignments between Shady Grove and the Metropolitan Grove MARC station. One uses thealignment of I-370 and I-270. The second follows the CSX railroad tracks to the Metropolitan Grove MARC station. From there, the alignment parallels I-270 across Seneca State Park to Germantown. Within Germantown, there are two alignments to serve the Employment Corridor. The alignment extends north on the east side of I-270 through Clarksburg. The third alternative alignment heads west to the Shady Grove area and then follows Great Seneca Highway to Quince Orchard Road, which it then follows to Metropolitan Grove. From there, it uses the same route as the second alignment.

Currently, the Germantown and Shady Grove Master Plans include the alignments, as will the Clarksburg Master Plan when it is adopted in 1994. The alignment from Clarksburg to Frederick was determined through a subsequent study by Frederick County. This part of the alignment is being added to the area master plans as they are amended.

The 1990 Shady Grove Study Area Amendment proposed a transitway loop from the Corridor Cities Transitway serving the Life Sciences Center. A transit connection to the south via MD 28 ("Southern Transitway") is also indicated on that master plan. If adopted, the recently issued Shady Grove-Gaithersburg Master Plan Amendment would delete the Southern Transitway as well as the Life Sciences Center Transitway. The Amendment would also place the Corridor Cities Transitway on the Gaithersburg Vicinity Master Plan and modify the alignment in three places within the Shady Grove Study Area.

Portions of the alignments of the Corridor Cities Transitway are in the Cities of Gaithersburg and Rockville. They are in the process of annexing property that includes a section of the proposed right-of-way. The cooperation and approval of these municipalities are needed to protect the alignment.

Georgetown Branch Transitway

The Georgetown Branch Transitway, or Bethesda-Silver Spring Trolley, will connect the Silver Spring Metro station with the Bethesda Metro station. It uses an abandoned railroad right-of-way and is specified in detail in the Georgetown Branch Master Plan, adopted in 1990. An MIS is underway to determine the best use of the right-of-way.

North Bethesda Transitway

This transitway connects the Grosvenor Metrorail station with Montgomery Mall via Rock Spring Park. This facility is recommended in the recently adopted

North Bethesda-Garrett Park Master Plan. It is currently planned as a suspended light rail technology, contingent upon winning funds by the US Department of Transportation over two other projects.

G. Master-planned HOV Facilities

Only one of the approved area master plans includes HOV facilities among the transportation facilities needed to serve the land use and zoning recommendations of the master plan. The North Bethesda-Garrett Park Master Plan recognizes HOV lanes as planned by SHA on the east and west spurs of I-270. As mentioned before, these lanes are on the background network.

H. Regional Facilities

The list on the following page notes significant improvements to regional facilities that are included in the background transportation system for the Transitway and HOV Network Master Plan. The background network also includes those facilities identified by the Metropolitan Washington Council of Governments (COG) which defines the Long Range Plan (LRP) in cooperation with all participating jurisdictions. The LRP is currently undergoing revision in order to comply with new restrictions imposed by the Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991. The analyses used the facilities in the previously adopted Long Range Plan (as amended in 1993).

Regional Facilities in the Background Network

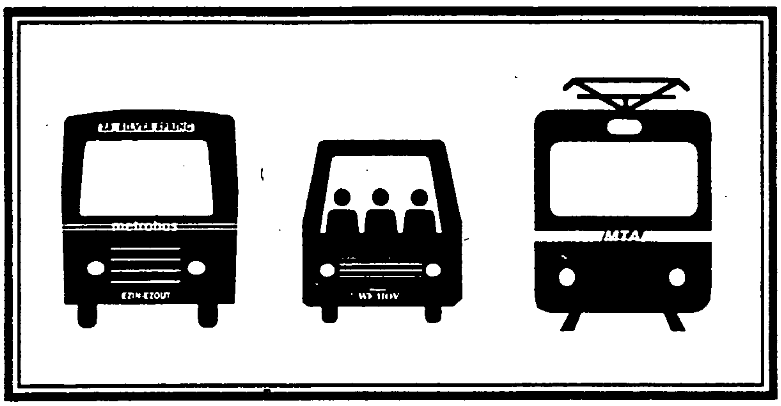
Highways

- Widening of the Capital Beltway between US 50 and I-95 in Prince George's County
- The Intercounty Connector
- Widening of Kenilworth Avenue (MD 201) from I-95 to the Capital Beltway (I-495)
- Extending MD 410 from the Baltimore-Washington Parkway to US 50
- Widening of US 50 (John Hanson Highway) from MD 410 extended to Patuxent River
- Widening of MD 214 (Central Avenue) from I-95 to US 301
- Widening of MD 4 (Pennsylvania Avenue) from US 301 to the Capital Beltway (I-495)
- Widening of MD 5 (Branch Avenue) from US 301 to the Capital Beltway (I-495)
- Widening of MD 210 (Indian Head Highway) from MD 225 to the Capital Beltway (I-495)

- Widening of Dulles Toll Road in Fairfax County
- Widening of I-66 in Fairfax County

HOV Priority Lanes

- I-95 from MD 24 to I-695
- I-83 from Belfast to I-695
- I-695 from I-97 to I-95 north of Baltimore
- I-70 from I-695 to US 40
- I-95 from I-695 to I-495
- US 29 from Silver Spring to MD 198
- I-270 from I-70 to I-495
- I-495 from Woodrow Wilson Bridge to American Legion Bridge
- I-97 from I-695 to US 50/301
- US 50/301 from MD 70 to I-95
- MD 4 from I-95 to US 301
- MD 5 from I-95 to US 301
- MD 210 from I-95 to MD 373
- Intercounty Connector from I-270 to US 1


metrobus
MTA

APPENDIX F

REGIONAL LAND USE FORECASTS

Appendix F

Regional Land Use Forecasts

Contents

Figures

Tables

Appendix F Regional Land Use Forecasts

This appendix outlines the prominent trends of the Round 4.1 land use forecasts produced by the Metropolitan Washington Council of Governments (COG) in co-operation with local jurisdictions. Round 4.1 uses the base year of 1990 and ultimately forecasts for the year 2010.

Future commuting patterns in the region will change depending on the expected pace and layout of population, housing, and employment growth. New transportation plans, including this Transitway and HOV Network Master Plan, must consider these future patterns in order to maintain and improve mobility around the region. The Montgomery County Planning Department uses the Round 4.1 population, housing, and employment forecasts as the assumed future land use data in the TRAVEL/2 transportation model.

A. Population

Overall, population in the Capital region is expected to increase by almost a million people between 1990 and 2010. However, as seen in Figure F-1, this population growth will not be distributed evenly among the areas into which COG separates the region. These areas, along with population data, can be found in Table F-1.

The Outer Suburbs are anticipated to swell by over 515,000 people, over half (52 percent) of the population growth for the entire region. The Inner Suburbs are expected to add 435,000 people to their ranks, or 44 percent of the growth, and the Central Jurisdictions are forecast to receive the remaining four percent.

Another number to compare across the jurisdictions is the growth rate, or the growth as compared to the previous population. The growth rate of the Outer Suburbs will be equally impressive at 43 percent. This is compared with over 19 percent for the Inner Suburbs and a subdued four percent in the Central Jurisdictions. Montgomery County's population growth rate, at 16 percent, is expected to lag behind the region's, 23 percent.

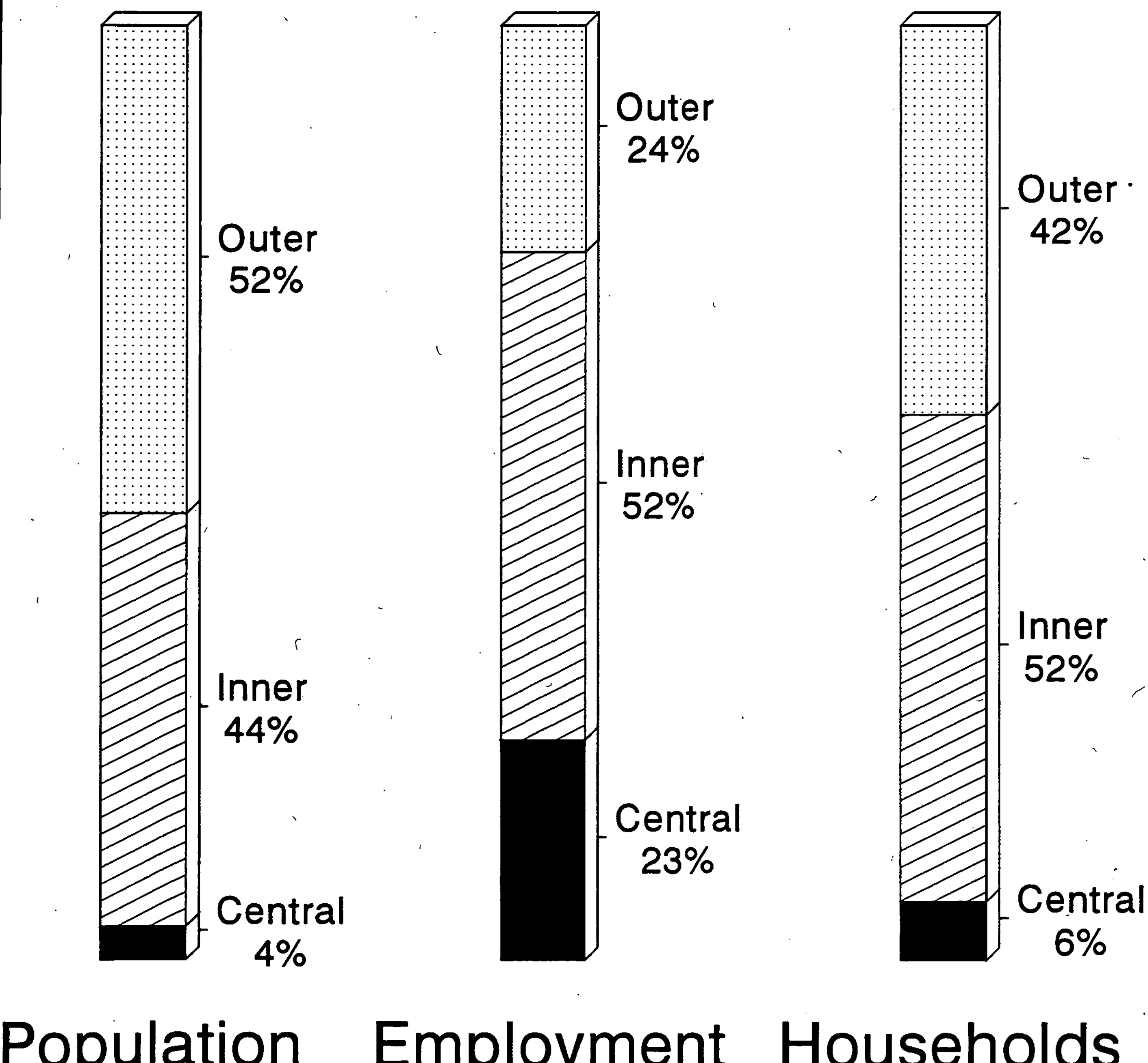
Table F-1
COG Round 4.1 Population Forecasts

	1990	2010	Real Growth	Growth Rate
	(in thousands)			
Central				
DC	628.3	627.7	-0.6	-0.1%
Arlington	167.0	178.8	11.8	7.1%
Alexandria	111.1	135.0	23.9	21.5%
Central Area Total	*906.4*	*941.5*	*35.1*	*3.9%*
Share of Region	*20.7%*	*17.5%*	*3.6%*	
Inner				
Montgomery County	710.0	820.0	110.0	15.5%
Prince George's Cnty	718.4	840.9	122.5	17.1%
Fairfax County	825.8	1028.4	202.6	24.5%
Inner Suburb Total	*2254.2*	*2689.3*	*435.1*	*19.3%*
Share of Region	*51.5%*	*50.1%*	*44.0%*	
Outer				
Loudoun County	89.8	210.9	121.1	134.9%
Prince William Cnty	277.0	390.2	113.2	40.9%
Charles County	103.8	161.5	57.7	55.6%
Frederick County	149.1	243.6	94.5	63.4%
Howard County	176.1	250.5	74.4	42.2%
Anne Arundel County	420.7	478.0	57.3	13.6%
Outer Suburb Total	*1216.5*	*1734.7*	*518.2*	*42.6%*
Share of Region	*27.8%*	*32.3%*	*52.4%*	
Regional Total	***4377.1***	***5365.5***	***988.4***	***22.6%***

Figure F-1

Share of Total Projected Growth

1990 - 2010



From MWCOG Round 4.1 Forecasts

This pattern is consistent with trends that have been building for the last twenty years. Worth noting are the dramatic growth rates in areas of the region once thought to be rural: Loudoun County (135 percent) in Virginia, and Frederick (63 percent) and Charles (56 percent) Counties in Maryland.

Almost exactly half the region is expected to live in the Inner Suburbs, the proportion unchanging from 1990 to 2010. However, the share of the Outer Suburbs will increase at the expense of the Central Jurisdiction, upping the former by five percent to almost a third of the region.

B. Employment

Employment growth in the Washington region is expected to expand by more than 40 percent between 1990 and 2010 (Table E-2). The bulk of new jobs is forecast to be in the Inner Suburbs (52 percent), with the remaining growth split evenly between the Outer Suburbs and Central Jurisdictions. Montgomery County's job growth rate is expected to be approximately 47 percent, slightly higher than the regionwide rate of 42 percent.

The Outer Suburbs, however, are expected to experience the highest growth rate in the region, although only slightly higher than in the Inner Suburbs (54 percent versus 50 percent). The small difference between the two is misleading because it is primarily due to one county, Anne Arundel. Anne Arundel's growth rate is well below the region's at 11 percent over 20 years. This stagnancy is weighted heavier than the rest of the Outer Suburbs since nearly a third of the jobs in the Outer Suburbs are located there. Without Anne Arundel, the growth rate of the Outer Suburbs is 88 percent. Further, the four counties with the highest growth rates are all in the Outer Suburbs: Loudoun (191 percent) and Prince William (89 percent) Counties in Virginia, and Frederick (118 percent) and Charles (60 percent) Counties in Maryland.

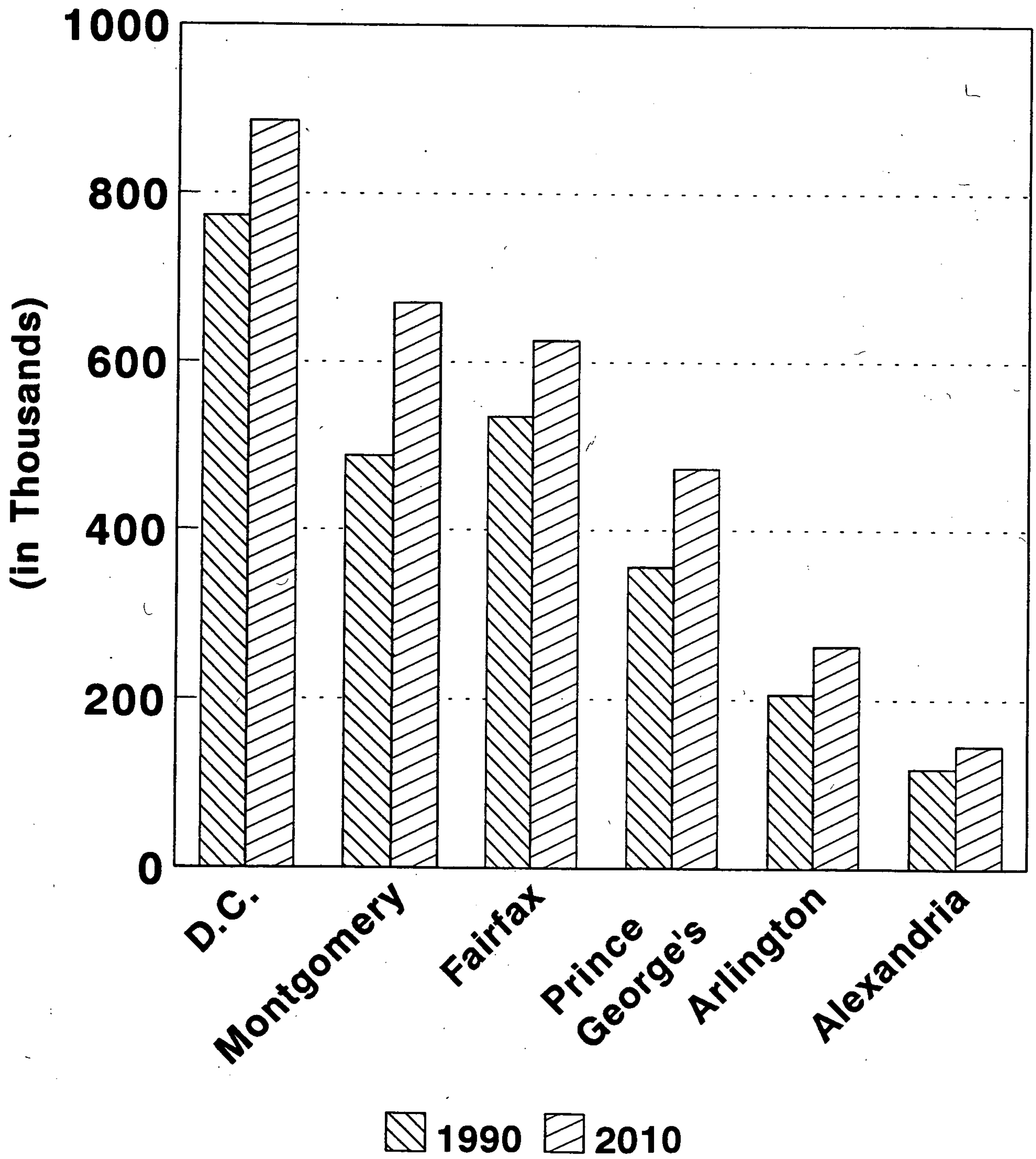
Employment growth in the Central Jurisdiction is expected to be lower than the other areas at 26 percent, although it will continue to be a primary locale for jobs, as 34 percent of the region's job's will be located within its more limited boundaries. While the paradigm of suburb-to-center work travel is becoming undermined and diluted by dramatic job growth in the suburbs, it continues to possess significance even 20 years from now.

Table F-2
COG Round 4.1 Employment Forecasts

	1990	2010		
	(in thousands)		Real Growth	Growth Rate
Central				
DC	718.2	886.0	167.8	23.4%
Arlington	214.6	263.6	49.0	22.8%
Alexandria	97.7	145.2	47.5	48.6%
Central Area Total	*1030.5*	*1294.8*	*264.3*	*25.6%*
Share of Region	*38.0%*	*33.7%*	*23.4%*	
Inner				
Montgomery County	455.0	670.0	215.0	47.3%
Prince George's Cnty	311.8	473.0	161.2	51.7%
Fairfax County	411.8	625.4	213.6	51.9%
Inner Suburb Total	*1178.6*	*1768.4*	*589.8*	*50.0%*
Share of Region	*43.4%*	*46.0%*	*52.3%*	
Outer				
Loudoun County	33.8	98.3	64.5	190.8%
Prince William Cnty	75.5	142.9	67.4	89.3%
Charles County	34.8	55.5	20.7	59.5%
Frederick County	54.0	117.5	63.5	117.6%
Howard County	84.2	117.9	33.7	40.0%
Anne Arundel County	223.7	247.9	24.2	10.8%
Outer Suburb Total	*506.0*	*780.0*	*274.0*	*54.2%*
Share of Region	*18.6%*	*20.3%*	*24.3%*	
Regional Total	***2715.1***	***3843.2***	***1128.1***	***41.5%***

Figure F-2

Regionwide Employment
1990 - 2010



From MWCOG Round 4.1 Forecasts

Table F-3
COG Round 4.1 Household Forecasts

	1990 (in thousands)	2010 (in thousands)	Real Growth	Growth Rate
Central				
DC	259.3	264.8	5.5	2.1%
Arlington	81.4	96.0	14.6	17.9%
Alexandria	56.4	72.0	15.6	27.7%
Central Area Total	*397.1*	*432.8*	*35.7*	*9.0%*
Share of Region	*23.7%*	*19.3%*	*6.2%*	
Inner				
Montgomery County	280.0	371.0	91.0	32.5%
Prince George's Cnty	262.9	337.0	74.1	28.2%
Fairfax County	316.3	448.2	131.9	41.7%
Inner Suburb Total	*859.2*	*1156.2*	*297.0*	*34.6%*
Share of Region	*51.3%*	*51.5%*	*51.9%*	
Outer				
Loudoun County	31.0	77.4	46.4	149.7%
Prince William Cnty	88.9	142.7	53.8	60.5%
Charles County	33.4	58.5	25.1	75.1%
Frederick County	53.1	92.5	39.4	74.2%
Howard County	64.8	101.8	37.0	57.1%
Anne Arundel County	147.3	185.1	37.8	25.7%
Outer Suburb Total	*418.5*	*658.0*	*239.5*	*57.2%*
Share of Region	*25.0%*	*29.3%*	*41.9%*	
Regional Total	***1674.8***	***2247.0***	***572.2***	***34.2%***

Table F-4
Persons per Household

	1990	2010
Central Area	2.28	2.18
Inner Suburbs	2.62	2.33
Outer Suburbs	2.91	2.64
Montgomery County	2.54	2.21
Regional Total	***2.61***	***2.39***

As seen in Figure F-2, employment is expected to continue to grow faster in Montgomery County than in the region as a whole. While the preliminary COG Round 5 forecast sees Fairfax County as the largest suburban employer by 2010, the Round 4.1 forecast, upon which the transportation model is based, envisions that Montgomery County will continue to be the largest suburban employer in the region, with 670,000 jobs projected for 2010. Regardless of which forecast proves to be more accurate, it is expected that a growing proportion of all commuters in the Washington region will be using roads and transit in Montgomery County.

C. Households

The trend toward smaller households is expected to continue, diminishing regionwide from 2.61 to 2.39 persons per household (Table E-3). Nearly all new households in the region will be created in the Inner and Outer Suburbs (93 percent). The change in the growth of smaller households is also more intense in these two areas, meaning that households are growing at a faster rate than the population is. Montgomery County will have the third largest household size change, its average plummeting from 2.54 to 2.21. Only Prince William and Charles Counties will experience greater drops. The rate of household growth outstrips the rate of population growth in every single jurisdiction.

D. Round 5.1

While nearing the end of the evaluation used in the Alternatives Report, COG issued a new set of land use forecasts, Round 5.0, which forecast patterns of employment, household, and population growth for the year 2020. These forecasts have since been slightly modified in Round 5.1. In response to these new forecasts, a legitimate question for this Master Plan is whether its recommendations would be changed if it used them.

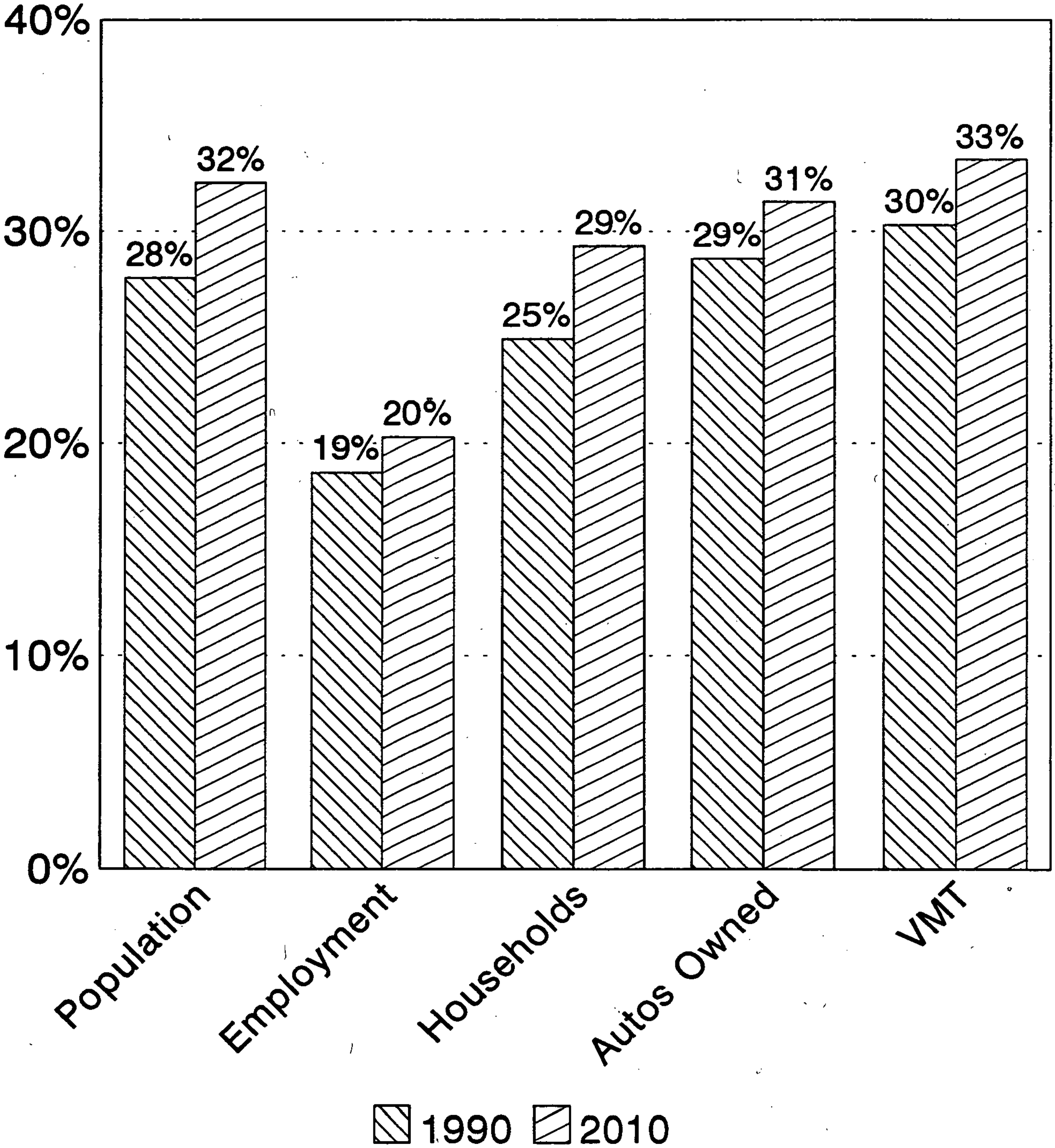
They would not. While the Round 5.1 forecasts project slower growth than those from Round 4.1, they do not see a significant change in the metropolitan landscape. Existing patterns of development would generally be continued. The next few paragraphs present a short synopsis of the differences between the two forecasts.

Two general statements can be made about the Round 5.1 forecasts:

(1) Round 5.1 projects more population growth than Round 4.1. Even by the year 2010, every jurisdiction is forecast to have more population growth except for the City of Alexandria and Loudoun County.

Outer Suburban Shares

1990 - 2010



Outer Suburbs: Loudoun and Prince William Counties in Virginia;, Charles, Frederick, Howard, and Anne Arundel Counties in Maryland.

From MWCOG Round 4.1 Forecasts

(2) Round 5.1 employment and household forecasts are not as strong as Round 4.1. If the growth rates for Round 4.1 were extended into the future, the Round 5.1 projections for 2020 would generally match those from Round 4.1 for 2015.

Montgomery County's population, household, and employment growth under Round 5.1 forecasts mirror these general trends. For population under Round 5.1, nearly 75,000 more people than forecast by Round 4.1 are forecast to live in the County by the year 2010. Household growth for 2010 also falls in line with the region: 30.6 percent growth in households in the County versus 30.1 percent in the region. Employment growth is affected somewhat more. While Round 4.1 employment forecasts saw Montgomery County's growth by 2010 as a few percentage points <u>more</u> than the regional average (47.3 percent versus 44.5 percent), those from Round 5.1 see it as a few percentage points <u>less</u> than the regional average (34.3 percent versus 36.8 percent).

E. Implications

The implications stemming from the forecasts are not necessarily new, but are lent further support by these data. The movement of both jobs and people to the Outer Suburbs has been going on for quite some time, so the numbers related to this, while dramatic (<u>Figure F-3</u>), are not as surprising as they might seem.

While the number of people in the region will increase by 18 percent, the household rate will increase by more, 25 percent. This indicates smaller households throughout the region. In addition, vehicle ownership in the region is expected to grow at a faster rate than population, employment or households (<u>Table E-4</u> and <u>Figure F-4</u>). Also, the number of cars per household in the region is expected to increase from 1.84 to 1.99. This, along with the previously mentioned downward change in household size, suggests that the number of private vehicles is approaching the number of licensed drivers in the Washington region.

The growth of road use in Montgomery County has risen faster than the growth in lane miles (<u>Figure F-5</u>). Vehicle miles traveled on State roads in the County increased by over 100 percent in the past 20 years, while total lane miles increased by about only 16 percent. Forecasts indicate that the number of vehicle miles of travel on State roads will double again by 2010. Vehicle miles of travel on all roads in Montgomery County are expected to grow by almost 46 percent by 2010, slightly less than the increase of 51 percent regionwide (<u>Table E-5</u>).

Table F-5
Vehicle Ownership Forecast

	1990 (in thousands)	2010 (in thousands)	Real Growth	Growth Rate
Central				
DC	224.3	273.3	49.0	21.8%
Arlington	112.4	120.1	7.7	6.9%
Alexandria	73.7	82.7	9.0	12.2%
Central Area Total	*410.4*	*476.1*	*65.7*	*16.0%*
Share of Region	*13.3%*	*10.7%*	*4.7%*	
Inner				
Montgomery County	581.9	813.2	231.3	39.7%
Prince George's Cnty	521.9	772.6	250.7	48.0%
Fairfax County	682.0	1000.0	318.0	46.6%
Inner Suburb Total	*1785.8*	*2585.8*	*800.0*	*44.8%*
Share of Region	*58.0%*	*57.9%*	*57.8%*	
Outer				
Loudoun County	49.5	143.3	93.8	189.5%
Prince William Cnty	195.3	339.7	144.4	73.9%
Charles County	73.0	127.5	54.5	74.7%
Frederick County	99.8	182.0	82.2	82.4%
Howard County	143.4	215.8	72.4	50.5%
Anne Arundel County	321.7	392.1	70.4	21.9%
Outer Suburb Total	*882.7*	*1400.4*	*517.7*	*58.6%*
Share of Region	*28.7%*	*31.4%*	*37.4%*	
Regional Total	***3078.9***	***4462.3***	***1383.4***	***44.9%***

Table F-6
Vehicles per Household

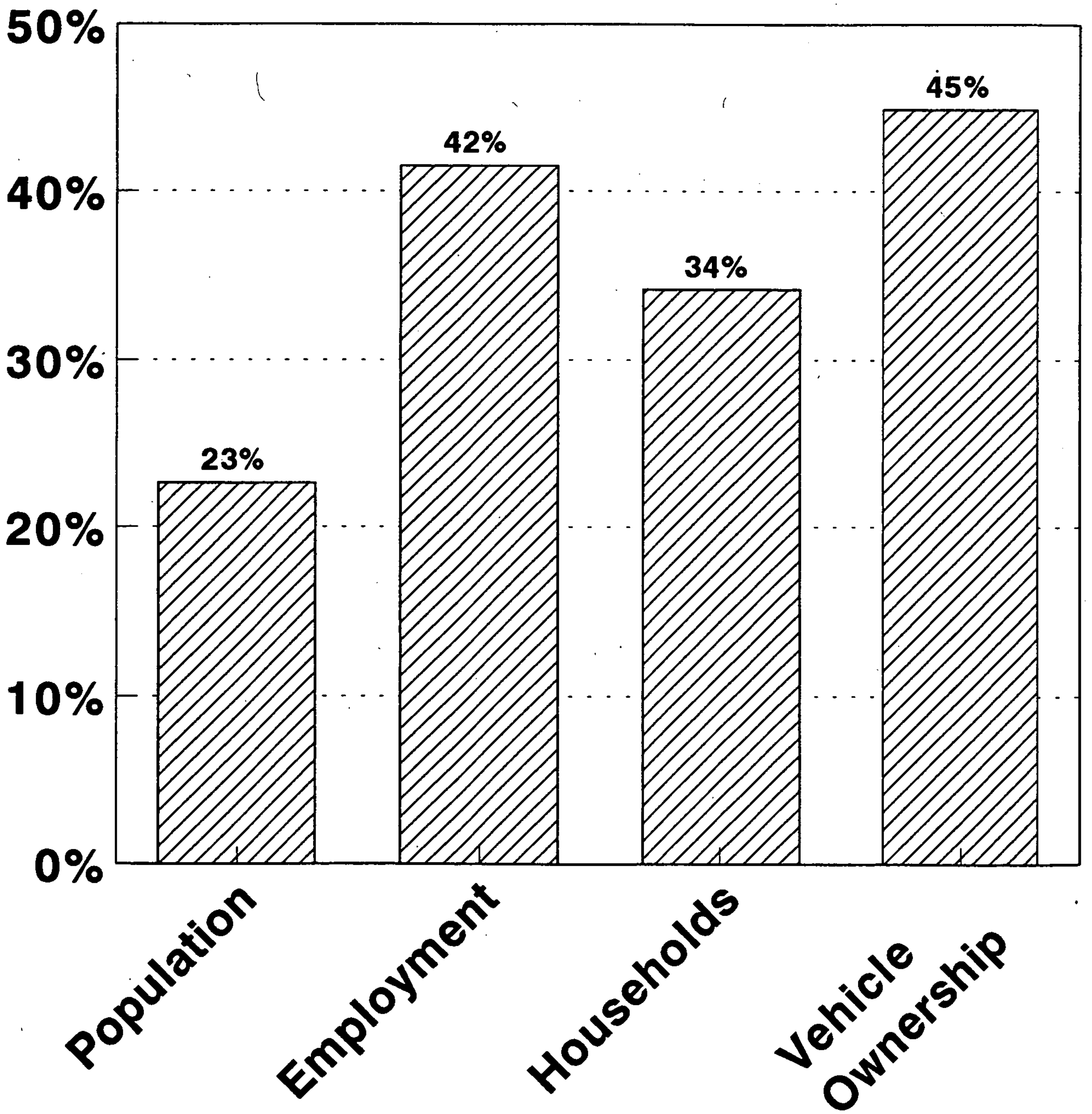
	1990	2010
Central Area	1.03	1.10
Inner Suburbs	2.08	2.24
Outer Suburbs	2.11	2.13
Montgomery County	2.08	2.19
Regional Total	***1.84***	***1.99***

Vehicle ownership forecast from COG/TPB document "The Highway and Transit Facility Element of the Long-Range Transportation Plan for the National Capital Region," December 4, 1992, p. 25.

Figure F-4

Vehicle Ownership Dominant Growth Trend

1990 - 2010



From MWCOG Round 4.1 Forecasts

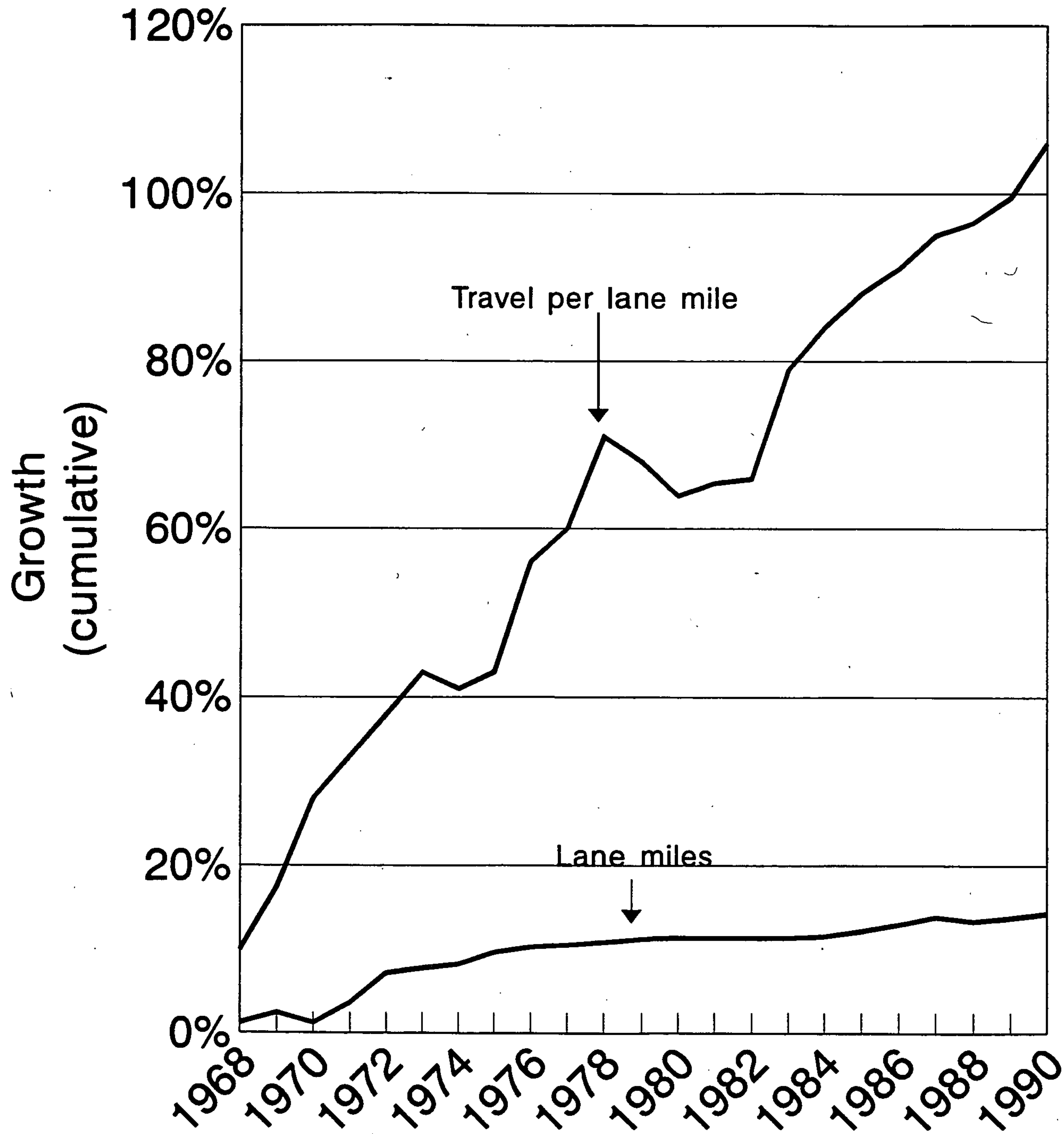
Table F-7
Vehicle Miles Traveled

	1990	2010		
	(in thousands)		Real Growth	Growth Rate
Central				
DC	8.1	10.4	2.3	28.4%
Arlington	3.3	4.0	0.7	21.2%
Alexandria	2.0	2.5	0.5	25.0%
Central Area Total	*13.4*	*16.9*	*3.5*	*26.1%*
Share of Region	*13.8%*	*11.5%*	*7.1%*	
Inner				
Montgomery County	16.8	24.5	7.7	45.8%
Prince George's Cnty	18.4	27.6	9.2	50.0%
Fairfax County	18.9	28.5	9.6	50.8%
Inner Suburb Total	*54.1*	*80.6*	*26.5*	*49.0%*
Share of Region	*55.8%*	*55.1%*	*53.5%*	
Outer				
Loudoun County	1.3	3.3	2.0	153.8%
Prince William Cnty	4.9	8.5	3.6	73.5%
Charles County	2.1	3.7	1.6	76.2%
Frederick County	4.9	8.9	4.0	81.6%
Howard County	5.8	9.4	3.6	62.1%
Anne Arundel County	10.4	15.1	4.7	45.2%
Outer Suburb Total	*29.4*	*48.9*	*19.5*	*66.3%*
Share of Region	*30.3%*	*33.4%*	*39.4%*	
Regional Total	***96.9***	***146.4***	***49.5***	***51.1%***

Vehicle Miles of Travel forecast from COG/TPB document, "The Highway and Transit Facility Element of the Long-Range Transportation Plan for the National Capital Region," December 4, 1992, p. 28. VMT forecast for the year 2010 by the Montgomery County Planning Department TRAVEL/2 transportation model may differ.

Figure F-5

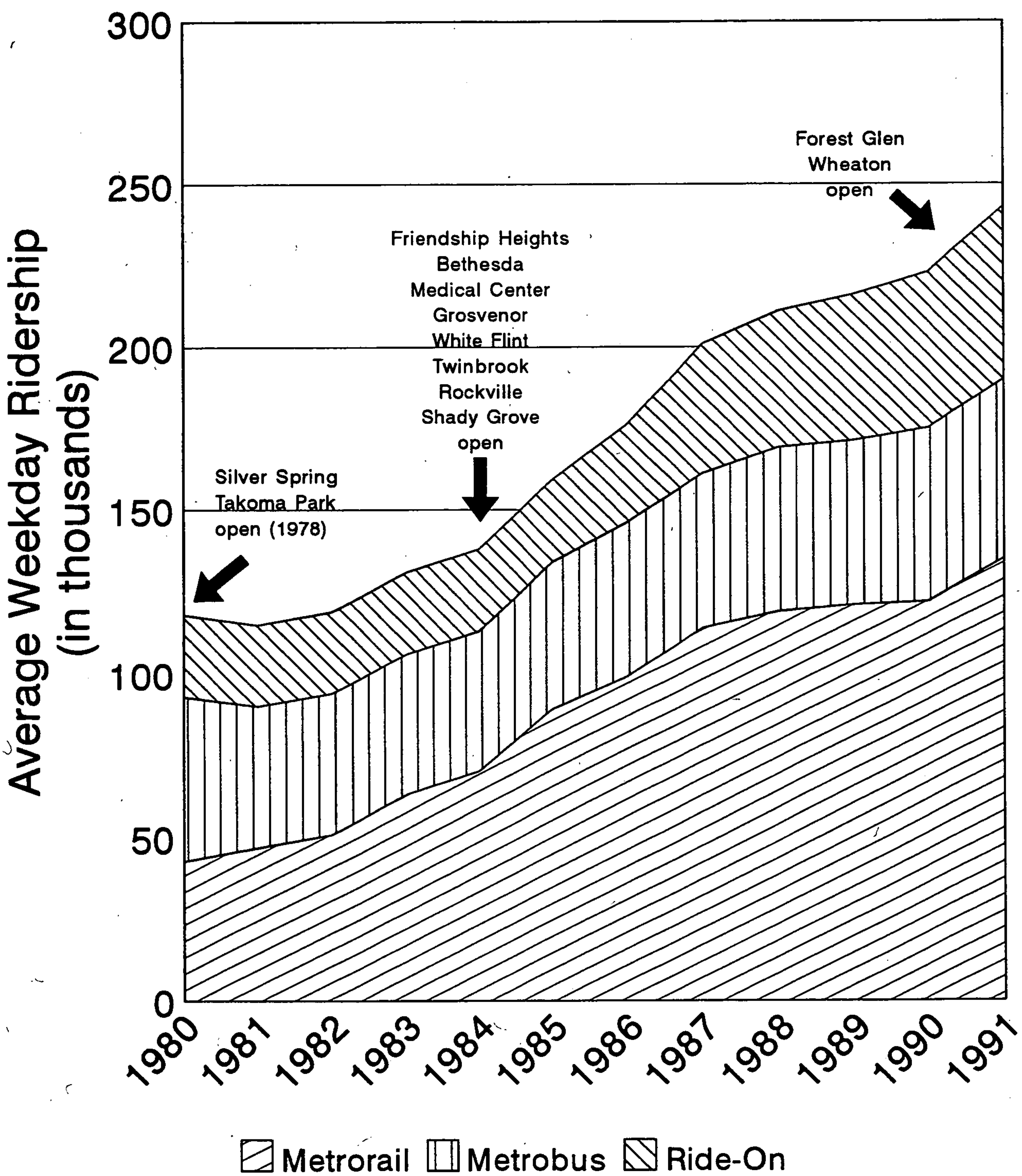
Road Use on State Roads Has Grown Faster Than Supply



Source: Maryland State Highway Administration and Montgomery County Planning Department

Figure F-6

Transit Ridership Has Doubled in Montgomery County Since 1980



Source: Washington Metropolitan Area Transit Authority

The number of transit passengers doubled between 1980 and 1990 in Montgomery County (Figure F-6). Excluding commuter rail (MARC), about 230,000 Montgomery County passengers used the transit system on an average weekday in 1990, double the approximately 115,000 weekday riders during 1980. The Metrorail, Metrobus and Ride-On Bus systems all experienced an increase in ridership as new stations opened along the Red Line in the 1980s; from 1989 to 1992, the number of autos on Georgia Avenue (MD 97) dropped by nearly 500 while the newly opened Wheaton and Forest Glen stations picked up almost 5,000 riders. Whether these transit riders switched from driving alone is unclear. However, the existing transit system will not have enough capacity to accommodate continued growth in transit ridership. Anticipated additional demand for transit will require the construction of new transitways, busways, and HOV lanes.

F. Conclusion

The changing travel patterns of the existing population, coupled with the addition of many new people, jobs, and automobiles in the region, predominantly in the suburbs, will cause increases in the anticipated vehicle miles of travel. At the same time, there is limited ability to increase the number of lane miles of road in the region. The result will be increased congestion and greater growth constraints. In order to meet the travel demands of the future regional population, additional transit and HOV facilities will be needed if unacceptable levels of congestion and constraints on growth are to be alleviated.

APPENDIX G

FUNCTIONAL

CLASSIFICATION

OF

TRANSPORTATION

ELEMENTS

Appendix G

Functional Classification of Transportation Elements

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Appendix G Functional Classification of Transportation Elements

A. Introduction

This appendix provides a functional comparison of the following five basic elements of the transportation system:

- pedestrian ways,
- bicycle paths,
- roadways,
- transitways, and
- high-occupancy vehicle (HOV) facilities.

Each of these elements has an important role in the planning of transitway and high-occupancy vehicle (HOV) networks. In addition, each element provides necessary segments of commuting trips, as shown in Figure G-1.

Each element will be described using a consistent set of functional parameters: purpose, types of facilities, slope or grade, width of facility, speed of travel, spacing of intersections or stops, and people-moving capacity. Where possible, local examples of the transportation elements have been given. The factors of speed, spacing of access points, and people-moving capacity will be compared for the elements. In some cases the different types of facility will be considered separately because of significant differences in characteristics.

The parameter of capacity is an important comparison between transportation modes. It is, however, very difficult to determine in a consistent manner. First, there is also an established use of the term "people-moving capacity" in regard to high-occupancy vehicle (HOV) facilities that is not consistent with the use in relation to normal roadways. HOV facilities are said to increase the people-moving capacity of a roadway. While the actual capacity — either each vehicle's seating capacity or the roadway's vehicle-moving capacity — is not increased, the minimum occupancy of

each vehicle is. The true people-moving capacity of any freeway lane can be achieved by a line of filled buses traveling at 35 mph. The addition of HOV restrictions to a lane does nothing to change this. In other words, HOV lifts the floor rather than raises the ceiling.

Further, pedestrian and bicycle facilities are not typically measured in people-moving capacity. For this appendix, staff proposes a people-moving capacity based on assumptions of speed and separation for each. This capacity is not a realistic assessment of local usage of such facilities but instead measures how much they could be used if there were sufficient demand. Sidewalks, for example, only reach their capacity in extremely dense urban environments such as downtown Manhattan or Chicago and separated bikeways are not used to capacity anywhere in this country. The measurement of capacity for such facilities is more for theoretical, rather than practical, comparison.

B. Pedestrian Ways

Purpose

Pedestrian routes are primarily intended to facilitate walking for enjoyment, recreation, and/or to reach a destination.

Types

- Sidewalks: generally parallel to the edge of a roadway.
- Paths and trails: generally pass through parks or other natural areas.

Functional Parameters

- Width and grade of pedestrian ways:

  Sidewalks are generally five feet or more in width and of a slope equalling that of the abutting roadway.

  Paths and trails are more variable in both width and grade.

- Access to sidewalks is generally from entrances from the adjacent building and at street intersections. Access to paths and trails are more widely spaced, typically being at intersections with other trails or sidewalks.

- People tend to walk up to approximately 4 miles per hour unless they are hurrying to catch a bus or to reach a destination by a particular time.

- The capacity of pedestrian ways is rarely, if ever, achieved. For comparative purposes: a five-foot-wide sidewalk can accommodate one person walking in each direction; if a pedestrian is walking at a pace of three miles per hour and there is a five-foot separation between people, then the sidewalk can accommodate over 6,300 people per hour in both directions. This assumes that the people on the sidewalk walk a perfectly constant speed, do not trip over any obstructions or bump into one another, and are unimpeded by cross movements.

  The 1985 Highway Capacity Manual states that sidewalk capacity is 25 pedestrians per minute per foot of sidewalk width. This translates to approximately 1.7 mph walking speed and just over 7 square feet of space per person. Since this number was derived primarily from non-sustained bursts (usually of less than 5 minutes) in dense urban areas with sidewalks of up to 50 feet, this measurement cannot be simply transferred to a five-foot sidwalk. Still, it is interesting to note that it computes the capacity of a five-foot sidewalk as 7,500 people per hour.

C. Bicycle Routes

Purpose

Routes that are intended primarily for people riding bicycles for enjoyment, recreation, commuting purposes, and/or to reach a destination.

Types

- Class I - Bike paths or trails: an independent path on a separate right-of-way or easement, including a sidewalk where adequately designed for the use of bicycles.

- Class II - Bike Lanes: a restricted right-of-way on a roadway, designated by striped pavement marking or by a physical barrier and signing for the exclusive or semi-exclusive use of bicycles.

- Class III - Bike Routes: a roadway shared by motor vehicles, bicycles, and/or pedestrians and designated by signing only.

Functional Parameters

- Width of bicycle facilities
  Class I - 10 to 12 feet wide
  Class II - minimum width of 5-feet
  Class III - no minimum width specified

- Slopes greater than 5 percent are undesirable but are acceptable for lengths of less than 500 feet when higher design speed is used and additional width is used.

- Bicycle routes should be designed to accommodate travel of at least 20 mph, although such speeds are probably not attainable on those facilities with both bicyclists and pedestrians.

- The theoretical capacity of a separate bike path wide enough for two lanes based on a 20-foot spacing between cyclists, plus six feet for each bicycle, and a 15 mph average speed is just over 6,000 vehicles per hour in both directions. This makes much of the same assumptions as in the discussion of sidewalk capacity: none of these theoretical bicyclists can get a flat tire and all must travel at a perfectly constant 15 mph, unimpeded by pedestrians that might be sharing the path.

D. Roadways

Purpose

Roadways are provided for the operation of motorized vehicles such as motorcycles, automobiles, vans, trucks, and buses for enjoyment, to reach a destination, or to move freight.

Types

- Limited Access Freeways: designed primarily to provide through service with limited or controlled land access. Local examples are I-270 and the Capital Beltway (I-495).

- Major Highways: provide a high level of traffic service and a low level of land access. Examples in Montgomery County include Rockville Pike (MD 355) and Georgia Avenue (MD 97).

- Arterial Roads: provide a balance between traffic service and land access. Local examples include Wilson Lane (MD 188) in the

Bethesda-Chevy Chase Area, Bel Pre Road in Aspen Hill, and Fairland Road in Eastern Montgomery County.

- Residential Collector Streets: residential collector streets, such as primary residential roads, provide a moderate level of traffic service and a high level of land access. Examples of this are found throughout residential developments in Montgomery County.

Functional Parameters

Note that the capacity for each of these roadway types can be and is occasionally exceeded, especially on very congested stretches of limited access freeways where cars are driven too close to one another. In addition, the variances within each roadway type can be great. The numbers here are indicative of typical facilities rather than recommendations for all facilities.

- Limited Access Freeways: generally 6 to 8 lanes in a right-of-way 300 to 600 feet wide; interchanges are spaced at a minimum of approximately one mile (5,000 feet) apart; posted speed 55 mph (65 mph in some states); capacity per lane 1,800 to 2,100 vehicles per hour; maximum grade: 5 percent.

- Major Highways: generally 4 to 6 lanes in a right-of-way 120 to 150 feet wide; intersections are spaced at a minimum of 600 to 750 feet apart; posted speed 40 to 50 mph; capacity per lane 1,400 to 1,800 vehicles per hour; maximum grade: 6 percent.

- Arterial Roads: 2 to 4 lanes in a right-of-way 80 to 100 feet wide; intersections are spaced at a minimum of 750 feet apart; posted speed 35 to 45 mph; capacity per lane 1,100 to 1,500 vehicles per hour; maximum grade: 8 percent.

- Residential Collector Streets (Primary Residential Roads): 2 lanes in a right-of-way up to 70 feet wide; although there is no specified minimum intersection spacing, a separation of 100 feet between intersections is a reasonable minimum in most cases, although driveway spacing varies with the type of development; posted speed 25 to 30 mph; maximum grade: 8 percent. Vehicular capacity of residential collector streets is generally not determined since the mathematically-correct 800-1,200 vehicles per hour is significantly greater than the maximum anticipated volumes given the densities of development

E. Transitways

Purpose

Exclusive routes for transit vehicles

Types

- Heavy Rail: service generally operates on an exclusive right-of-way, often in a subway, elevated, or some combination. Heavy rail vehicles are powered by an electrified third rail and provide high-speed service to urban and densely developed suburban areas. A local example is the Washington Metropolitan Area Transit Authority's Metrorail system.

- Commuter Rail: generally provides line-haul service from suburban — as well as exurban and rural — areas to central employment areas using existing rail lines. MARC and Virginia Rail Express are local examples.

- Light Rail: uses vehicles powered by an electrified overhead catenary operating singly or in short trains on fixed guideways; light rail service usually is provided by at-grade rail tracks with limited sections of grade-separated crossings (elevated or in a subway) of roadways or environmentally sensitive areas. In a few situations the service is elevated as a monorail with the cars above the track or suspended with the cars below an overhead track. While the Washington metropolitan area does not have light rail at this time, the recently opened Baltimore Central Light Rail is a local example.

- Busway: similar to light rail lines except that the service is provided by buses that use the exclusive right-of-way for all or a portion of the trip. There are no local examples of a busway, as the only two systems in North America exist in Pittsburgh, Pennsylvania and Ottawa, Ontario.

Functional Parameters

- Heavy rail
  maximum grade: 4 percent
  minimum physical width: 30 feet*
  minimum station spacing: 5,000 feet (except in some urban locations)
  maximum speed: 75 mph
  peak capacity: 24,800 people per hour per track

- Commuter Rail
  - maximum grade: 6 percent
  - minimum physical width: 30 feet*
  - minimum station spacing: 10,000 feet (except in some urban locations)
  - maximum speed: 70 mph
  - peak capacity: 30,000 people per hour per track

- Light Rail
  - maximum grade: 8 percent
  - minimum physical width: 29 feet (double-track)*
  - minimum station spacing: 1,320 feet
  - maximum speed: 55 mph
  - peak capacity: 7,785 people per hour per track

- Busways
  - maximum grade: 6 percent
  - minimum physical width: 12 feet per lane*
  - minimum station spacing: 1,320 feet
  - maximum speed: 55 mph
  - peak capacity: 6,570 people per hour

*The minimum physical width does not include any type of buffer that may be necessary to shield surrounding land uses from the facility.

F. HOV Facilities

Purpose

One or more lanes of a roadway where use is restricted to high-occupancy vehicles (HOVs) and/or transit vehicles during either the peak periods or all day, or a separated lane parallel to a roadway whose use is similarly restricted.

Types

- Exclusive HOV facility: I-66 inside the Capital Beltway (I-495) in Virginia is an example of such a facility where the entire roadway is restricted to HOVs during the peak period and direction.

- Contraflow HOV facility: HOV vehicles travel in the opposite direction of the rest of the traffic. Normally, this is used only by buses as safety requires professional drivers. Such a facility exists in New York's Lincoln Tunnel where buses carry over 30,000 people into New York through the outbound tunnel in the morning peak hour alone.

- Barrier or buffer-separated right-of-way: An example of this facility is the Shirley Highway (I-395) in Virginia, where both median HOV lanes are separated from the general use lanes by concrete barriers.

- Concurrent flow lane (diamond): A diamond lane can currently be found on the northbound east spur of I-270, where HOVs occupy the leftmost of the three existing lanes.

- Shoulder lane HOV: I-66 outside the Capital Beltway (I-495) in Virginia provides an instance of such a facility: during the peak hour, a signal over the right shoulder notifies commuters as to the availability of the lane (with a red 'X' or a green checkmark) while signs alongside inform them of the restrictions.

- Arterial street: Such facilities exist in Alexandria, Virginia, on Washington Street and US 1 (Patrick and Henry Streets).

Functional Parameters

- Width: the minimum width is 11 feet per lane, plus the barrier or buffer when part of the same right-of-way as the freeway.

- Maximum grade: the maximum grade is the same as a freeway or the roadway it is part of.

- Access spacing: there is no limitation of access between the general use lanes and the HOV lanes, except for barrier or buffer separated rights-of-way and HOV lanes on exclusive rights-of-way. In the case of barrier or buffer-separated facilities, the distances between access points is similar to that of the distances between interchanges so that vehicles can merge through the general use lanes to and from the interchanges.

- Speed: the design and posted speeds are the same as a freeway or the roadway it is a part of.

- Capacity: the vehicle capacity is the same as a freeway or as the roadway it is a part of, but the anticipated people-moving capacity is higher due to the minimum occupancy requirement.

Comparative Classifications of the Transportation Elements

Three parameters are used to present these elements in charts:

- Figure G-2 — distance between connections (land access versus through movement),
- Figure G-3 — people-moving capacity, and
- Figure G-4 — speed of travel.

Generally the longer the distance between connections, the higher the people-moving capacity and speed. Several classifications specified in the text are presented side-by-side for each element in Table G-1.

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Table G-1
Transportation Elements

	Minimum physical width (feet)[1]	Maximum slope	Minimum access spacing (feet)	Speed[2] (mph)	Capacity per lane (people per hour or vehicles per hour)
Pedestrian Ways					
Paths	5	8%	50	3	3,168 pph
Sidewalks	5	8%	20	3	3,168 pph
Bicycle Paths					
Class I	10-12	5%	100	15	3,046 vph
Class II	5	5%	100	15	3,046 vph
Class III	n/a	5%	n/a	n/a	3,046 vph
Roadways					
Freeway	300	5%	5,000	55	1,800-2,100 vph
Major Highway	120	6%	750	40-50	1,400-1,800 vph
Arterial	80	8%	750	35-45	1,100-1,500 vph
Residential Collector	48	8%	100	25-30	800-1,200 vph
HOV	11/lane	X[3]	X[3]	X[3]	X[3]
Transitways					
Heavy Rail	30	4%	5,000[4]	75	24,800 pph
Commuter Rail	30	6%	10,000[5]	70	30,000 pph
Light Rail	29	8%	1,320	55	7,785 pph
Busway	12/lane	6%	1,320	55	6,570 pph

[1] The minimum physical width does not include any type of buffer that may be necessary to shield surrounding land uses from the facility.

[2] Speeds for sidewalks and bikeways are based on average traveling speeds of pedestrians and bicyclists; speeds for roadways are posted speed limits; speeds for transitways represent the speed the technology is generally capable of.

[3] An HOV facility can be on a freeway, major highway, or arterial, and the characteristics of the HOV facility depend on the roadway it is on. Similar vehicle capacity exists between each lane of the HOV facilitiy and the paralleling roadway lanes, but more people per hour are moved on each HOV lane than any other parallel single lane.

[4] In urban locations, heavy rail station spacing can be as little as 2,500 feet.

[5] Commuter rail stations are occasionally located within 5,000 feet of one another.

COMBINATIONS OF MODES FOR TRAVEL FROM HOME TO WORK

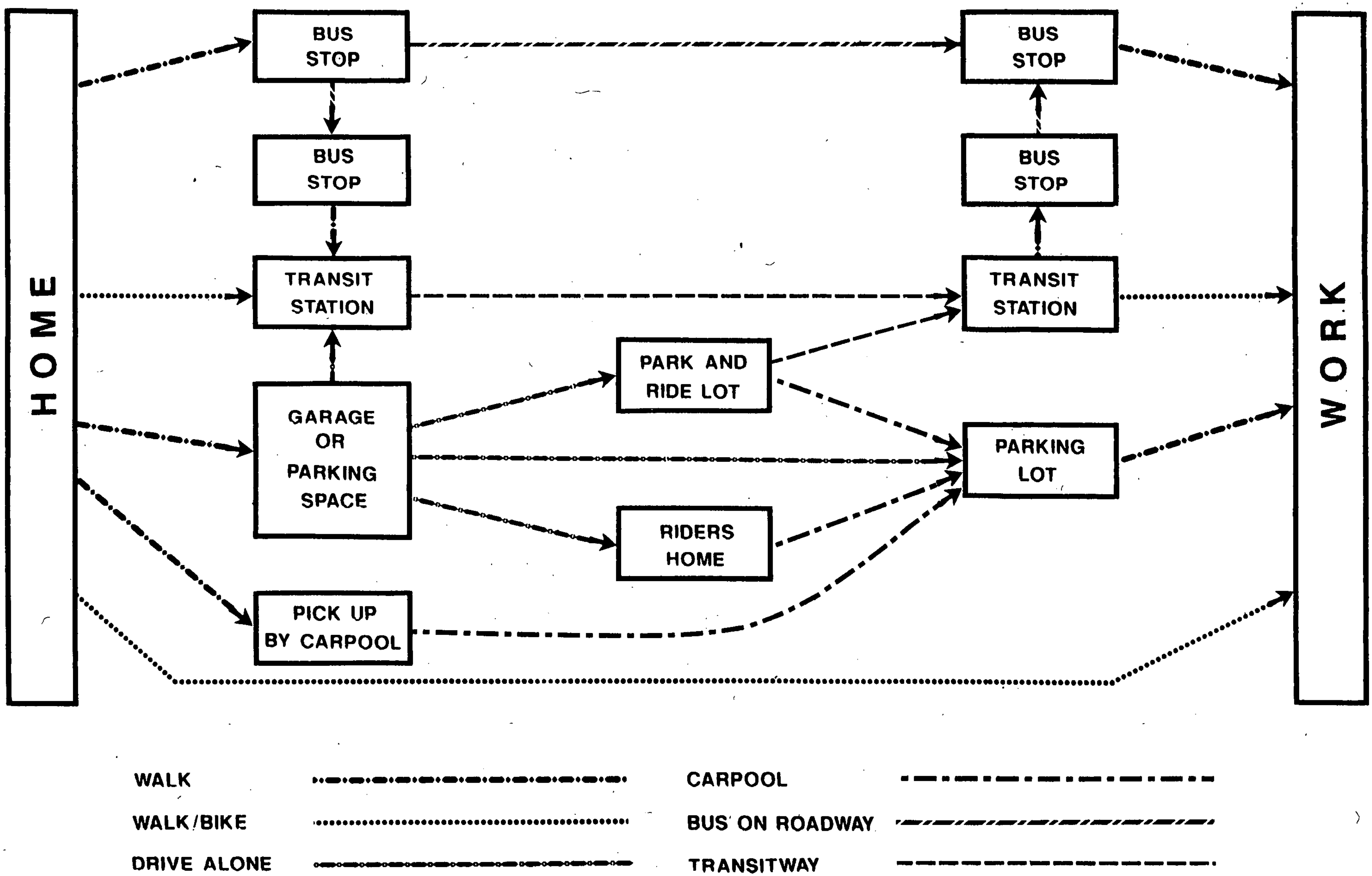
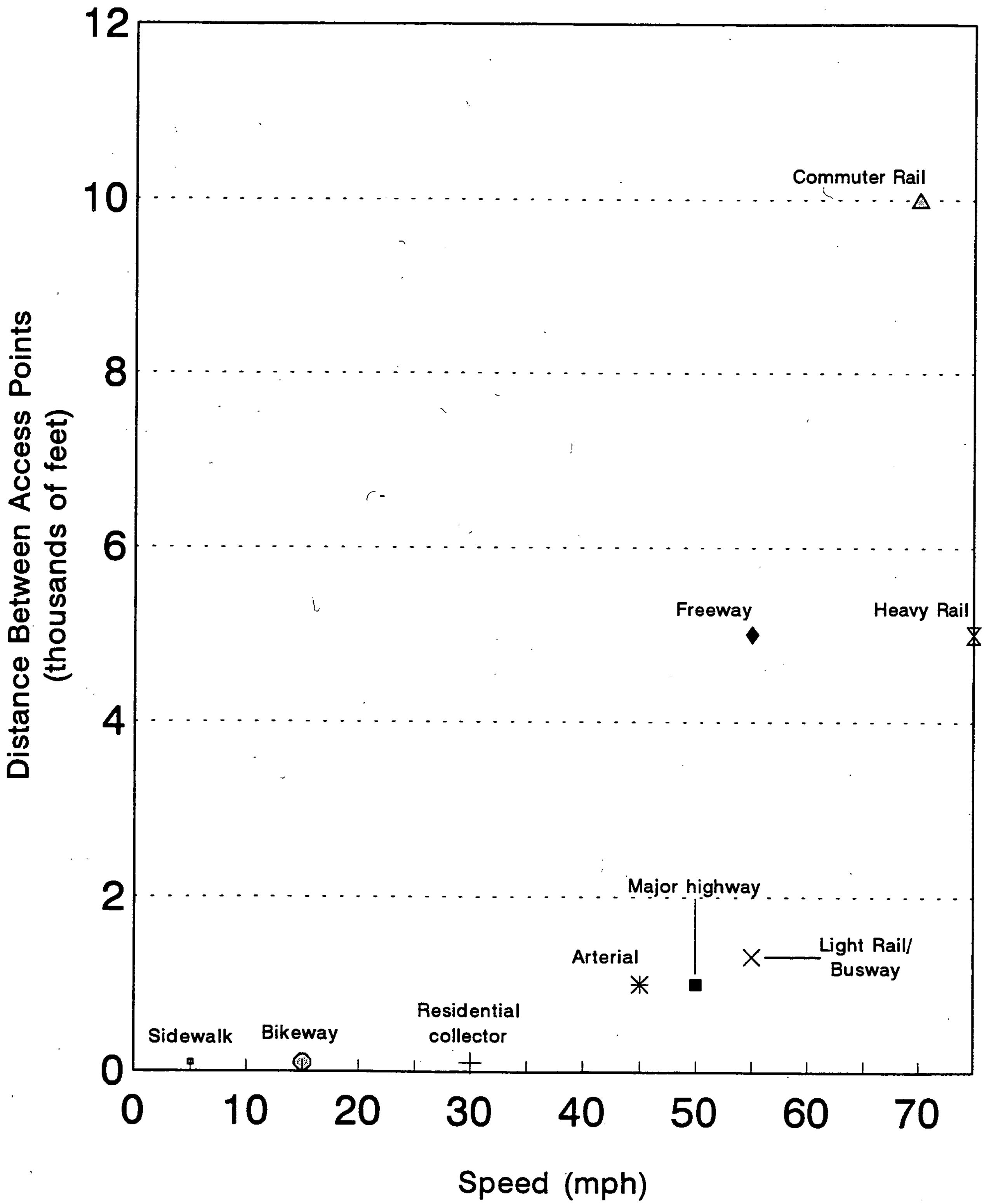


Figure G-2

Speed vs. Access Point Distance



Roadway speed is posted speed limit
Speed of transitway is general limit of technology
Speed of sidewalks and bikeways is average traveling speed

Peak Capacity of Transportation Elements

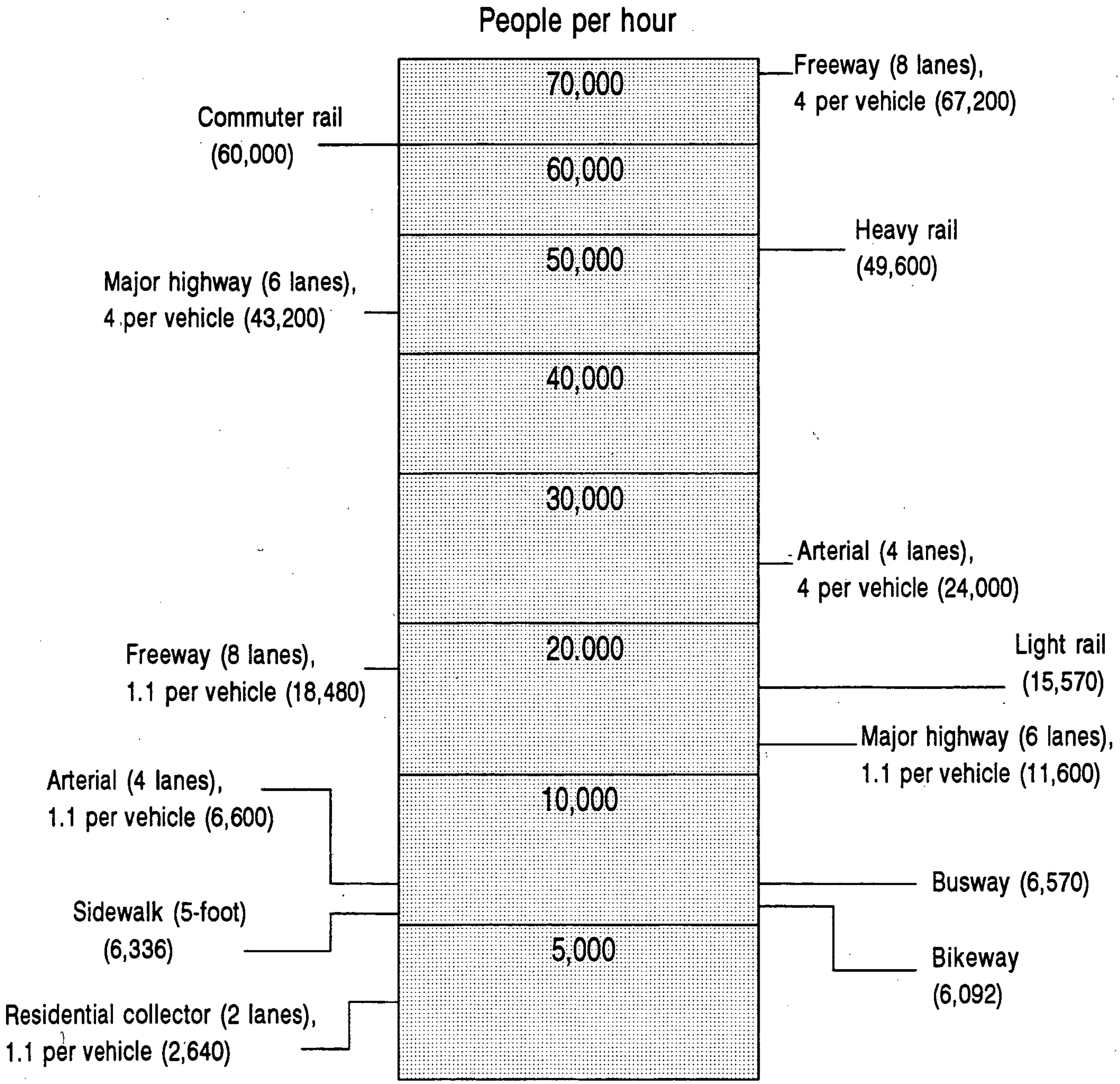
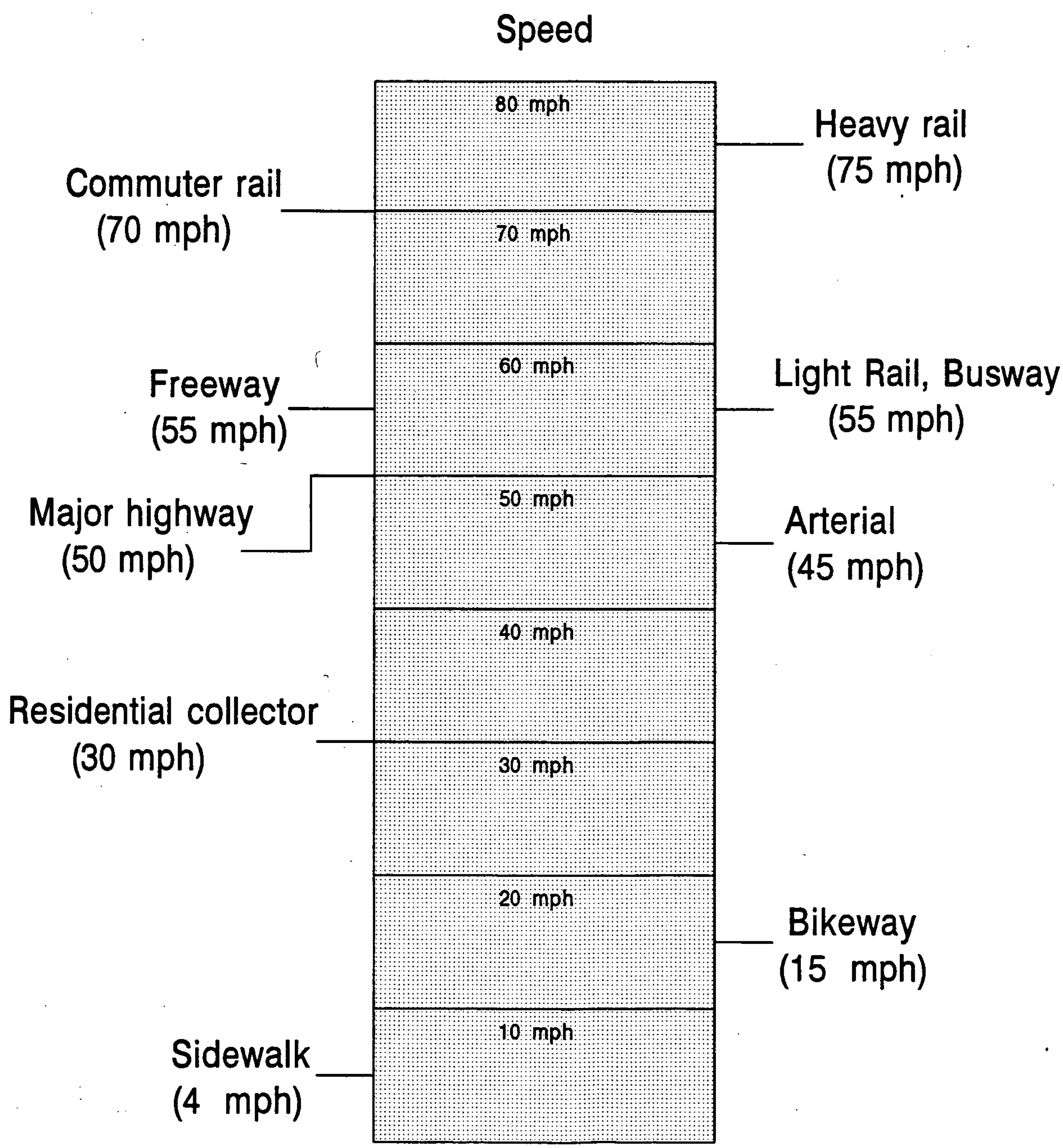


Figure G-4

Maximum Speed of Transportation Elements



APPENDIX H

HOV:

WHAT IS IT

AND

HOW DOES IT

WORK?

Appendix H

HOV

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Appendix H HOV

This appendix describes the characteristics and operations of High-Occupancy Vehicle (HOV) facilities. It was written to provide informational background for the development of the Transitway and High-Occupancy Vehicle Network Master Plan.

A. What Is "HOV"?

"HOV" is an acronym for High-Occupancy Vehicle. An HOV carries at least one passenger in addition to the driver and can be a car, a van, or a bus. An HOV lane is a special travel lane whose use is given exclusively to HOVs. The restrictions regarding use are normally for a specified time period, typically during peak commuting periods. Carpool lanes, commuter lanes, and express lanes are other names for HOV lanes.

B. What Is the Purpose of HOV Lanes?

The creation of HOV lanes is prompted by the need to resolve urban and suburban traffic congestion. HOV lanes provide a potentially effective means to manage transportation demand to significantly reduce congestion. This technique, however, is most effective when used as part of an overall transportation demand strategy. Such a strategy would include elements such as priority carpool/vanpool parking locations, policies regarding parking supply and cost at employment centers, transit fare subsidies, park-and-ride lots at accessible locations, and ridesharing programs.

The primary purpose of HOV lanes is to reduce traffic volumes by providing incentives to commuters who rideshare or use buses and thereby move them in fewer vehicles. The major incentives to use an HOV lane are travel-time savings and increased trip-time reliability. The resulting increases in ride-sharing and bus transit use by providing HOV lanes makes more effective use of existing and proposed roadway capacity. An increase in ridesharing and transit use enables more people to be accommodated by the available lanes. Thus, more people are able to travel in fewer vehicles when an HOV lane is added than if another general-use lane is added.

A reduction in traffic congestion resulting from the use of HOV lanes can provide increased mobility that is not otherwise obtainable. Due to limited existing

and expanded right-of-way availability along major roadways, restricted fiscal resources, or potential community and/or environmental impacts, new lanes cannot be added to congested roads. In these situations, the most effective way to alleviate congestion on the roadways is to increase the person-carrying capacity of existing lanes.

Following are several additional objectives HOV lanes aim to achieve:

- increase trip-time reliability
- reduce total travel-time
- reduce fuel consumption
- reduce air pollution
- improve efficiency of public bus transit operations
- defer or eliminate the need to respond to increasing vehicle congestion by widening existing roadways or building new ones

C. Why Would Someone Want to Use HOV Lanes?

There are three primary incentives for people to use HOV lanes to commute to and from work: travel-time savings, increased trip-time reliability, and reduced stress.

Significant travel-time savings can be achieved on HOV lanes, particularly if the trip takes more than 10 minutes. Speeds are generally faster on HOV lanes as compared with speeds on more congested general-use lanes. Secondly, trip-time reliability is increased for drivers using HOV lanes because congestion and traffic incidents on HOV lanes are reduced. As a result, stress is reduced for commuters who are no longer stuck in the typical bumper-to-bumper traffic of general use lanes.

These advantages — trip-time reliability, travel-time savings, and reduced stress — become obvious to commuters traveling in congested general-traffic lanes when they see the traffic moving by on the adjacent HOV lane.

D. How Is the Effectiveness of an HOV Lane Measured?

The use of HOV lanes is measured in terms of "people movement," not "vehicle movement." The number of people an HOV lane can carry per hour depends on the volume of traffic; the mix of buses, vans, and cars; and their occupancy levels. For example, the Route 495 Lincoln Tunnel is an exclusive bus lane linking northern New Jersey with Manhattan. It carries over 34,000 people per hour in the peak direction in approximately 725 buses.

A more typical example of HOV use is Route 55 in Orange County, California. Carpools and vanpools are permitted, but few buses use this HOV lane. The HOV lane carries approximately 4,000 people per hour in 1,700 vehicles. For comparison, a congested freeway lane where the vehicle volume exceeds the lane's capacity (Level of Service F), carries an average of 2,250 people in 1,800 vehicles. Both the Capital Beltway (I-495) between New Hampshire Avenue (MD 650) and I-270 and both spurs of I-270 north of the Beltway operate under similar conditions during the peak periods.

E. How Can HOV Lanes Carry More People When They Appear Empty?

An HOV lane carries between 1.4 and 2.7 times as many people during peak commuting periods as an adjacent general-use lane. Although the lane may appear underutilized, more people are moved on an HOV lane because there are more people per vehicle. Some HOV lanes carry almost half of all the people served on the entire freeway during the peak hour. The two reversible HOV lanes on Shirley Highway (I-395) in Northern Virginia, for example, carry approximately 60 percent of the people traveling on the highway in the peak hour. This percentage represents 5,000 more commuters than the four general-use lanes carry during the same period.

F. What Types of HOV Lanes Exist?

There are four general types of HOV facilities that carry traffic for long distances within or parallel to freeway rights-of-way. In addition, some HOV facilities currently operate on arterial roads. Further, special features exist that facilitate travel by HOVs. The cross sections for four different types of HOV lane configurations are seen in Figure H-1.

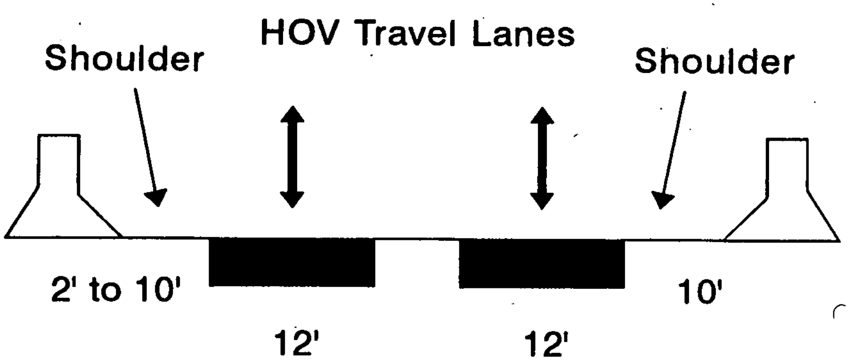
The most common type of HOV facility is the concurrent flow lane — commonly referred to as a "diamond lane." This is a facility where the lanes established for HOV use are part of a roadway and not separated from the general-use lanes by a barrier. The use restriction is indicated by both diamonds painted on the pavement and signs posted along the route. In the case of a diamond lane, the HOV restrictions often apply only during certain time periods — generally the peak commuting periods. During the other periods of the day, these lanes revert to general-use.

Another type of HOV facility is an exclusive, or barrier-separated, HOV lane or lanes. This facility is built for HOV use only and is physically separated from, but parallel to, the general-use lanes.

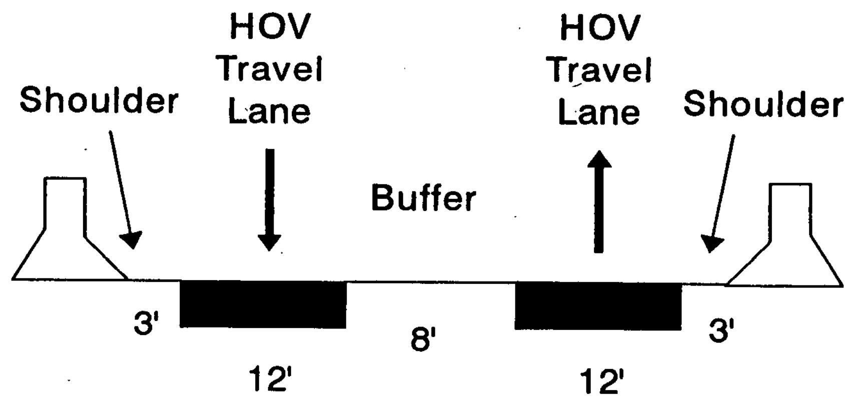
HOV Cross Sections

Figure H-1

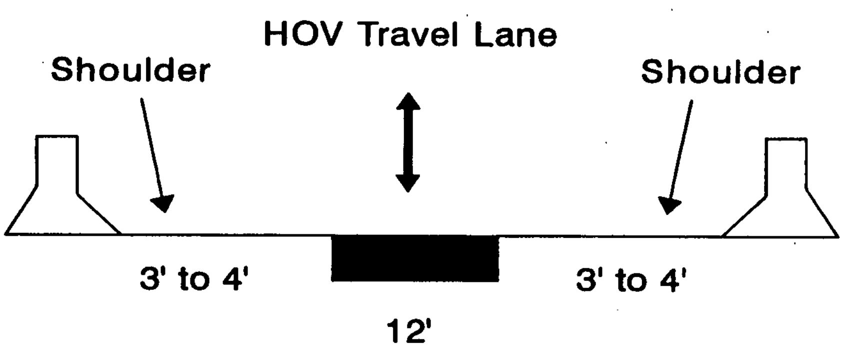
Typical Cross Section for Two-lane Reversible HOV Facility



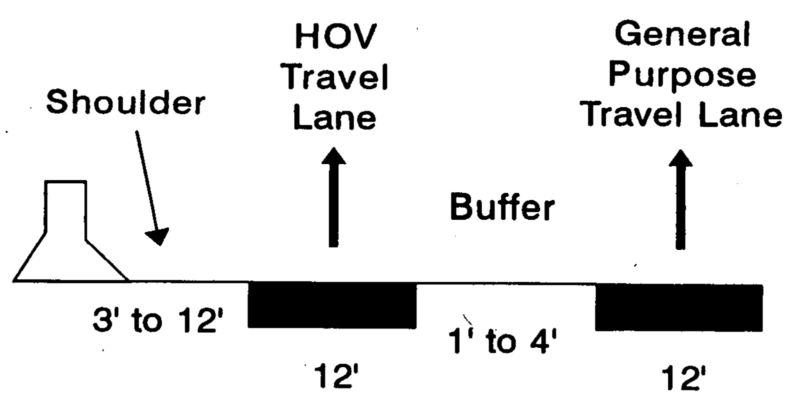
Typical Cross Section for Two-lane Two-way HOV Facility



Typical Cross Section for One-lane Reversible HOV Facility



Typical Cross Section for Concurrent Flow HOV Facility Separated by a Buffer from General Purpose Traffic



A contra-flow HOV lane uses the inside lane on the portion of the roadway intended for traffic going in the opposite direction. For safety reasons, contra-flow lanes are used exclusively by professional bus drivers.

A busway is an HOV facility that is completely separated from other traffic — it may be parallel to a general-use roadway or a completely separate roadway. Busways have their own access and egress points.

G. How Do HOV Lanes Work on Arterial Roads?

Arterial HOV lanes are generally located on the outside lanes and are designated by diamond symbols painted on the pavement as well as signs designating the times and occupancy requirements for the restricted use of the lane. These lanes can be restricted to buses only or can be available for automobiles as well. The purpose of the HOV lanes affects their location within the roadway and their effectiveness. Arterial road HOV lanes tend to be more successful when they are for express travel with minimal turning movements onto and off the HOV lane. The HOV lanes in Alexandria, Virginia are effective in reducing travel time because they are used almost exclusively by people passing through Alexandria on their way to and from work.

As shown on Map H-1 and described in Table H-1, Alexandria maintains an HOV lane on three separate roads in the peak direction. Since the HOV lanes are affected by different needs and limitations, the placement of them on the roads through Alexandria is not consistent. For instance, the northbound (morning peak) and southbound (evening peak) HOV lanes on Washington Street are both on the innermost, or curbside lane. But the southbound HOV (evening peak) lane on Route 1 (Henry Street) is on the far left lane. This is because the right lane exits onto the Capital Beltway (I-95/I-495) and if the HOV lane were also on the right, a confusing and possibly dangerous merging situation could arise. Finally, the northbound (morning peak) HOV lane on Route 1 (Patrick St.) is the second from the right, since on-street parking is maintained during rush hour.

In Washington, D.C., HOV lanes on the curb lanes of some major arterial roads were established in 1984 to serve local transit buses. However, local officials allowed too many exceptions to their use. Single-occupant vehicles were permitted to use the restricted lanes for dropping off or picking up passengers, or for making right turns. Special interest groups, including tour buses, taxis, and bicyclists, demanded and were granted use of the restricted lanes. The frequency of bus stops and turning movements by other vehicles eliminated the advantages for all users of the restricted lanes. Therefore, all of the HOV lanes were eliminated since any time savings were significantly reduced by frequent stops; the local buses ended up moving as slowly as the rest of traffic.

Enforcement of HOV restrictions on arterial roads is difficult when non-transit vehicles are permitted, especially where roads and driveways frequently intersect the facility. When a driver who is violating the HOV restrictions notices a police car, the driver only needs to turn off at the next driveway or street to avoid a costly ticket. Further, the delays caused by turning vehicles can reduce the advantages for transit vehicles. Cars parked on arterial lanes can also present an obstacle to smooth HOV flow on these facilities. Often, such facilities (such as Washington Street in Alexandria) exist as on-street parking in the off-peak period. Prompt towing and efficient signs can help eliminate this problem. Despite these limitations, arterial road HOV lanes are operating and under consideration in other regions.

H. What Other Issues Need to Be Addressed in Planning HOV Lanes?

Occupancy Level

Occupancy requirements should be high enough to keep congestion on the HOV lanes down, but low enough to enable sufficient usage to affect congested general-use lanes and, simultaneously, eliminate the appearance of an underutilized HOV lane. Typically, HOV occupancy levels range from 2+ (two or more people per vehicle) to 4+, to buses only. The higher the occupancy requirement, the higher the people-moving capacity of the HOV lane.

As an HOV lane becomes more popular, vehicle congestion on the lane will increase. The increased congestion reduces the advantages for using the HOV lane. By increasing the vehicle occupancy level of an HOV lane, the person-moving capacity of the lane can be increased, thereby reducing congestion and responding to the increased demand.

Map H-1 HOV Lanes in Alexandria, Virginia

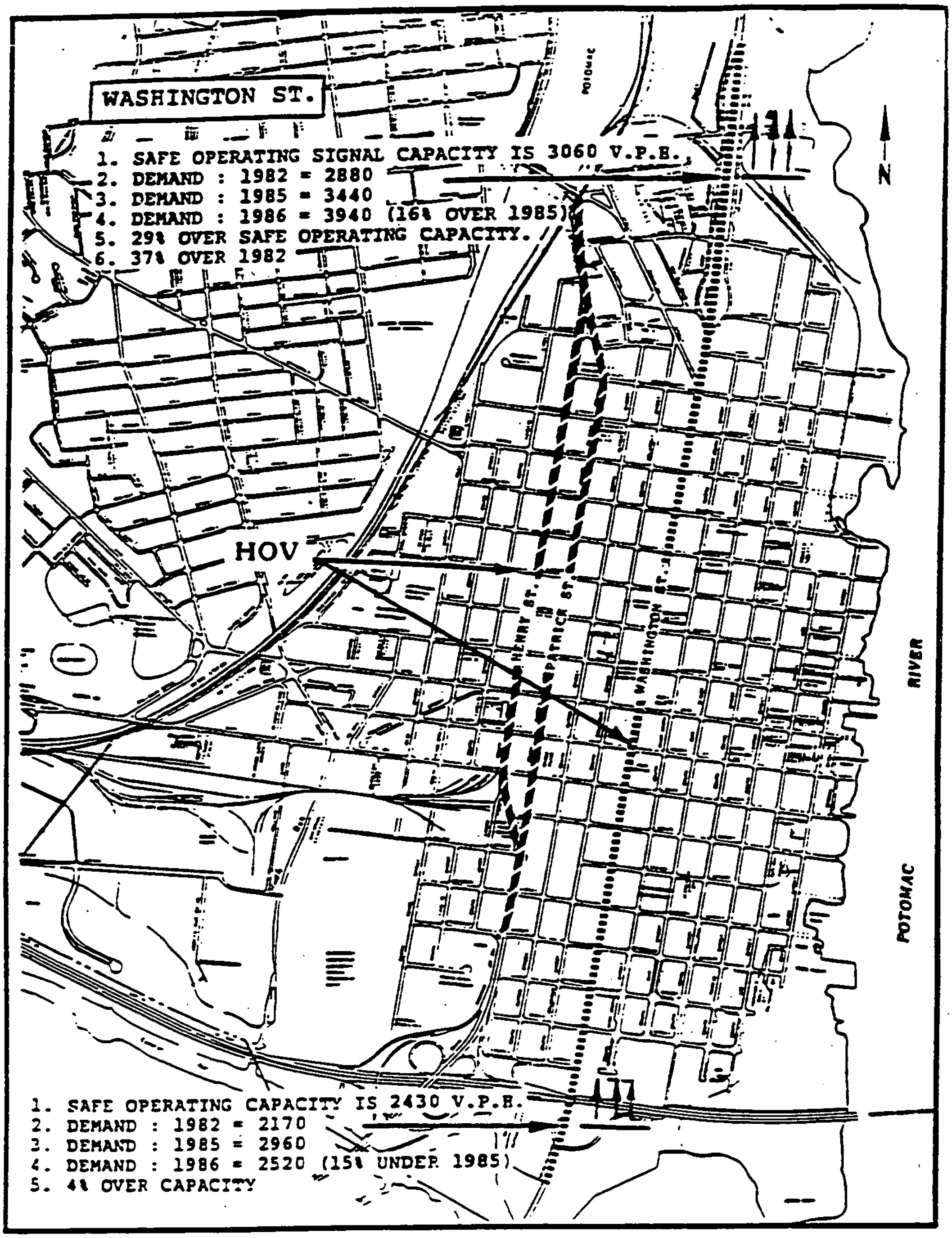


Table H-1 Alexandria HOV Lanes

Street	Hours of operation	Lane used	Bus service	Comments
Washington Street NB	7 - 9 am	Curb	No	Parking Prohibited during HOV use
Washington Street SB	4 - 6 pm	Curb	No	
Route 1 NB (Patrick Street)	6 - 9 am	Second from right curb	No	Hours extended at request of vanpool operators
Route 1 SB (Henry Street)	3 - 7 pm	Far left	No	

Hours of Restriction

Hours of operation vary among HOV facilities, but all restrict the use of the lane to HOVs for at least part of the peak commuting periods. In some instances, these restrictions may last for only an hour before the lane is returned to general use. Restrictions may extend for several hours in the morning and afternoon peak periods. Barrier-separated lanes and HOV lanes in separate rights-of-way often have 24-hour restrictions on the use of HOV lanes.

Phasing of Implementation

HOV lanes are often constructed in segments. In these cases, the operating agency must make a decision regarding the phasing of the HOV use restrictions on the segments as they become completed. Experience has shown that completed segments of lanes intended for future HOV use should not be opened initially to general-use traffic. Once drivers of single-occupant vehicles get accustomed to using the future HOV lane, they will object to its being restricted to HOV use.

Enforcement

There is a temptation for those driving alone in congested lanes to cheat and use the adjacent HOV lane(s) because traffic on those lanes moves quicker. This problem can be effectively controlled with driver education, strict laws, and appropriate enforcement. Providing areas for pull-offs and other necessary facilities so that law enforcement officers can check vehicle occupancy levels and issue citations to violators, therefore, is an essential part of the planning and establishment of an HOV project. In 1989, penalties nationally ranged from $40 to over $246 for the first offense.

Vehicle-type Restrictions

Generally, the criteria for determining which vehicles are eligible should relate to the purpose of the HOV lanes — moving more people in fewer vehicles — and to the public purposes of health, safety, and public welfare. Carpools, vanpools, and buses are clearly appropriate for HOV facilities except those restricted to buses only. From time to time, however, local agencies are petitioned by various special interest groups to have their vehicles included as eligible. These include the handicapped, off-duty enforcement and emergency personnel, VIPs, taxis, commercial trucks, deadheading transit vehicles (those returning to a garage or route that are empty except for the driver), emergency vehicles, and motorcycles. In light of the purpose of the HOV facility, clearly marked emergency vehicles and deadheading transit vehicles are appropriate. Taxis that meet the occupancy requirements would also be appropriate. Single-occupant commercial vehicles would not be appropriate as they do not contribute to reducing overall congestion by moving more people in fewer vehicles.

I. What Other Facilities and Services Are Needed to Support HOV Use?

Park-and-Ride Lots

Park-and-ride lots are designated places where carpools and vanpools can form. Bus passengers can also park and meet their bus at park-and-ride locations. Park-and-ride lots should provide free, all-day, paved parking. Lighting, shelters, and pay phones, as well as other facilities, are generally provided as well. Convenience retail and child day-care facilities at the lots could be useful and may help to attract new users.

Bus Transfer Stations

Bus transfer stations are locations where passengers can change from one bus route to another. Multiple bus routes converge at one central location, allowing passengers to transfer between bus lines easily. A transfer station enables a commuter to ride a local bus to the station and transfer to an express bus that uses an HOV lane for the remainder of the commute to work.

Transportation Demand Management Policies

Demand for HOV lanes is stimulated by policies that encourage and facilitate ridesharing or discourage single-occupant vehicle travel. Incentives to ridesharing include preferential parking locations at employment centers, while disincentives to single-occupant travel include limitations on parking supply and parking fees at workplaces.

J. What Special Features Have Been Used Along with HOV Lanes?

Queue Jumping

Exclusive ramps or lanes for HOVs that bypass bottlenecks at toll booths, congested intersections, or other points of congestion, and provide a time-savings for commuters.

Ramp Metering

Entrance onto some limited access highways is governed by a traffic signal on the on-ramp during periods of congestion. These signals regulate the pace at which cars are permitted to merge with the traffic already on the highway. Queues often form at the metered ramps. Providing a separate ramp or lane for HOVs with preferential signal timing can create a significant time savings.

Separate Access Ramps

The construction of separate access ramps dedicated exclusively for HOV use has the effect of providing exclusive HOV interchanges. These ramps are typically built as an extension of the median HOV lane and can provide additional time savings for HOV users who would otherwise have to make multiple lane changes to enter and exit the HOV facility. Separate access ramps can also be used to maintain a continuous HOV lane when two HOV routes intersect or merge.

Moveable Barriers

In an area where traffic in the peak direction, both in the morning and evening, is significantly higher than in the off-peak direction, and where there is no physical barrier dividing the two sides of a highway, moveable barriers can be used to temporarily shift a center lane for use in the peak direction. This is accomplished by providing a moveable barrier that can be shifted from one side of the lane to the other, separating the traffic in the peak and off-peak directions. One method in operation consists of a barrier of linked Jersey wall elements. After a peak period has ended, each element is picked up by a special vehicle and placed on the other side of the HOV lane in preparation for the next peak period. Shifting the location of the barrier adds the center lane to those serving the next peak period, and the added lane can be restricted to HOV use. In this manner, one lane can accommodate HOV use in both the morning and evening peak periods.

Although not an HOV facility, the use of the center lane of the Roosevelt Bridge (US 50 from Virginia to Washington DC) is alternated to the peak direction by a moveable barrier.

On-line Transfer Stations

On-line transit stations generally combine bus transfer stations and separate HOV access ramps. Buses on the HOV lane have direct access to the transit station that is located either above or adjacent to the freeway. Local buses serve the transit station from the street system and either exchange passengers with the express buses from the HOV lane, or enter the HOV lane through the transit station, or both.

K. Where are Existing and Planned HOV Facilities Located?

During the past 20 years, HOV lanes have become an increasingly important part of highway improvement programs in major metropolitan areas across the country, as shown on the attached lists of existing and planned HOV facilities prepared by the HOV Committee of the Transportation Research Board. These lists indicate the characteristics of those facilities in Canada and the United States as of January 1994.

Sources

Fuhs, Charles. 1990. High-Occupancy Vehicle Facilities: A Planning, Design, and Operation Manual.

JHK and Associates. 1990. High-Occupancy Vehicle (HOV) Source Book. Prepared for M-NCPPC, March.

Table H-2 Operational Characteristics of Selected Freeway/Expressway HOV Facilities as of January 1994

HOV Facility	# Lanes	Length (miles)	Hours	Eligibility	Rule changes?
Busways					
Ottawa, Ontario					
Southeast Transitway	1 each dir.	3.0	24 hours[1]	Buses	No
West Transitway	1 each dir.	6.5	24 hours[1]	Buses	No
Southwest Transitway	1 each dir.	2.5	24 hours[1]	Buses	No
Pittsburgh, PA					
East Busway	1 each dir	6.8	24 hours[1]	Buses	No
South Busway	1 each dir	4.1	24 hours[1]	Buses	No
Minneapolis, MN					
U-M intercampus busway	1 each dir	1.1	24 hours[1]	Buses	No
Barrier-Separated: Two-way					
Los Angeles, CA					
I-10 (El Monte)	1 each dir.	8.0	24 hours[1]	HOV 3+	From buses only
I-105/I-110 ramps	Connections to I-105 E & W	1.0	24 hours[1]	HOV 2+	No
I-10/I-710 ramps	1 each dir.	1.5	24 hours[1]	HOV 3+	From buses only
Northern Virginia, I-66	2-3 each dir.	9.6	6:30-9 am EB 4-6:30 pm WB	HOV 3+	Operating hours
Seattle, WA, I-90	1 each dir	1.5	24 hours	HOV 2+	No
Barrier-Separated: Reversible Flow					
Northern Virginia, I-395	2	11.0	6-9 am NB 3:30-6 pm SB	HOV 3+	From HOV 4+
Houston, TX I-10 (Katy)	1	12.3	4 am-1 pm, 2-10 pm	HOV 3+	Raised and lowered occ. requirements
I-45 (Gulf)	1	11.5	4 am-1 pm, 2-10 pm	HOV 2+	No
US 290 (Northwest)	1	13.5	4 am-1 pm, 2-10 pm	HOV 2+	No
I-45 (North)	1	13.5	4 am-1 pm, 2-10 pm	HOV 2+	Operating hours
US 59 (Southwest)	1	11.6	4 am-1 pm, 2-10pm	HOV 2+	No
San Diego, CA	2	8.0	6-9 am, 3-6:30 pm	HOV 2+	No
Minneapolis, MD, I-394	2	5.0	6-10 am, 3-6:30 pm	HOV 2+	No

Table H-2 Operational Characteristics of Selected Freeway/Expressway HOV Facilities as of Janurary 1994

HOV Facility	# Lanes	Length (miles)	Hours	Eligibility	Rule changes?
Pittsburgh, PA, I-279/579	1	4.1	5 am-noon, 2-8 pm	HOV 2+	From HOV 3+
Norfolk, VA, I-64	2	8.0	5-8:30 am WB, 3-6 pm EB	HOV 2+	No
Seattle, WA I-5 N Express Lanes	2-3	SB 2.6 NB 1.6	4 am-noon SB, 1 pm-3 am NB	HOV 2+	From HOV 3+
I-90	2	1.5	4 am-noon WB, 1 pm-3 am EB	HOV 2+	No
Concurrent-Flow: Buffer/Non Separated					
Vancouver, British Columbia					
H-99	1 each dir.	SB 4.0 NB 1.0	24 hours	Buses	No
Hartford, CT I-84	1 each dir.	10.0	24 hours[1]	HOV 2+	From HOV 3+
I-91	1 each dir.	9.0	24 hours[1]	HOV 2+	No
Los Angeles, CA					
SR 91	1 each dir.	8.0	24 hours[1]	HOV 2+	No
I-405	1 each dir.	9.4	24 hours[1]	HOV 2+	No
I-105	1 each dir.	16.0	24 hours[1]	HOV 2+	No
I-210	1 each dir.	18.5	24 hours[1]	HOV 2+	No
Orange County, CA					
I-5	1 each dir.	10.0	24 hours[1]	HOV 2+	No
SR-55	1 each dir.	11.0	24 hours[1]	HOV 2+	No
I-405	1 each dir.	24.0	24 hours[1]	HOV 2+	No
SR-57	1 each dir.	10.0	24 hours[1]	HOV 2+	No
Riverside Co., CA, Rt 91	1 each dir.	8.0	24 hours[1]	HOV 2+	No
Santa Clara/San Mateo Counties, CA					
US 101	1 each dir.	21.0	5-9 am, 3-7 pm	HOV 2+	No
SR 237	1 each dir.	6.0	5-9 am, 3-7 pm	HOV 2+	No
SR 85	1 each dir.	4.0	5-9 am, 3-7 pm	HOV 2+	No
I-280	1 each dir.	11.0	5-9 am, 3-7 pm	HOV 2+	No
San Tomas Expressway	1 each dir.	8.0	5-9 am, 3-7 pm	HOV 2+	No
Montague Expressway	1 each dir.	6.0	5-9 am, 3-7 pm	HOV 2+	No
Alameda County, CA, I-880	1 each dir.	5.0	5-9 am, 3-7 pm	HOV 2+	No
Contra Costa Cy, CA, I-580	1 each dir.	6.1	5-9 am, 3-7 pm	HOV 2+	No
Marin County, CA, US 101	1 each dir.	13.0	6:30-8:30 am 4:30-7:00 pm	HOV 2+	From HOV 3+

Table H-2 Operational Characteristics of Selected Freeway/Expressway HOV Facilities as of Janurary 1994

HOV Facility	# Lanes	Length (miles)	Hours	Eligibility	Rule changes?
Phoenix, AZ					
I-10	1 each dir.	19.0	24 hours[1]	HOV 2+	From HOV 3+
SR 202	1 each dir.	4.0	24 hours[1]	HOV 2+	No
Miami, FL, I-95	1 each dir.	12.0	7-9 am SB, 4-6 pm NB	HOV 2+	No
Ft. Lauderdale, FL, I-95	1 each dir.	27.0	7-9 am, 4-6 pm	HOV 2+	No
Orlando, FL, I-4	1 each dir.	30.0	7-9 am SB, 4-6 pm NB	HOV 3+	No
Honolulu, HI					
Moanaloa Freeway	1 each dir.	2.4	6-8 am, 3:30-6 pm	HOV 2+	No
Kalanianaole Highway	1 (WB)	2.0	5-8:30 am	HOV 2+	No
H-1	1 each dir.	8.0	6-8 am, 3:30-6 pm	HOV 2+	No
Ottawa, Ontario, Hwy 17	1 (WB)	3.0	7-9 am	Buses	No
Montgomery County, MD, I-270 East Spur	1 each dir.	2.5	6-9 am SB, 3:30-6:30 pm NB	HOV 2+	No
Minneapolis, MN, I-394	1 each dir.	7.0	6-9 am EB, 4-7 pm WB	HOV 2+	No
Nashville, TN, I-65	1 each dir.	5.1	7-9 am NB, 4-6 pm SB	HOV 2+	No
Northern Virginia					
I-95 (interim)	1 each dir.	5.0	6-9 am, 3:30-6 pm	HOV 3+	No
I-66	1 each dir.	7.0	6-9 am, 3-7 pm	HOV 2+	No
Norfolk/Virginia Beach, VA					
I-564	1 (EB)	2.0	3-6 pm	HOV 2+	No
SR 44	1 each dir.	4.0	5-8:30 am WB, 3-6 pm EB	HOV 2+	No
I-64	1 each dir.	5.0	5-8:30 am, 3-6 pm	HOV 2+	No
Seattle, WA					
I-5 (N of CBD)	1 each dir.	SB 7.4 NB 4.3	24 hours[1]	HOV 2+	From HOV 3+
I-90 (interim)	1 (WB), 2 (EB)	WB 5.0 EB 6.5	24 hours[1] 24 hours	HOV 2+	No
I-5 (S of CBD)	1 each dir.	SB 10.0 NB 10.6	24 hours[1]	HOV 2+	From HOV 3+
I-405	1 each dir.	SB 8.1 NB 8.6	24 hours[1]	HOV 2+	No

Table H-2 Operational Characteristics of Selected Freeway/Expressway HOV Facilities as of Janurary 1994

HOV Facility	# Lanes	Length (miles)	Hours	Eligibility	Rule changes?
SR 167	1 (NB)	1.1	24 hours[1]	HOV 2+	No
SR 520	1 (WB)	2.3	24 hours[1]	HOV 3+	From Bus-only in AM
Contraflow					
Honolulu, HI					
Kalanianaole Highway	1 each dir.	WB 4.4 EB 1.0	5-8:30 am 4-6:30 pm	HOV 2+	From HOV 3+
Kahekili Highway	1 each dir.	1.1	5:30-8:30 am 3:30-7 pm	HOV 2+	No
New York, NY					
Rte 495 (Lincoln Tunnel)	1	2.5	6-10 am EB	Buses	No
Long Island Expressway	1	4.0	7-10 am WB	Bus, taxis, vanpools	No
Dallas, TX	1 each dir.	WB 5.2 EB 3.3	6-9 am 4-7 pm	HOV 2+	From HOV 3+ and operating hours
Montreal, Quebec					
Champlain Bridge, Rt. 10,15,20	1	4.3	6:30-9:30 am NB 3:30-7 pm SB	Buses	No
Queue Bypasses					
Bay Area, CA					
Bay Bridge Toll Plaza, I-80	3 (WB)	0.9	6-9 am, 3-6 pm	HOV 3+	No
Dumbarton Br. Toll, Rt. 84	1 (WB)	2.0	6-9 am, 3-6 pm	HOV 2+	From HOV 3+
San Mateo Bridge, SR-92	1 each dir.	1.0	6-9 am, 3-6 pm	HOV 3+	No
Various entry ramps	1	0.1	When demand warrants	HOV 2+	No
Los Angeles and Orange Counties, CA					
Over 250 entry ramps	1	0.1	When demand warrants	HOV 2+	No
SR-14 Emergency bypass	1 (SB)	5.0	24 hours	HOV 2+	No
I-10W Emergency bypass-es	Varies	2.0	24 hours	HOV 2+	No
San Diego, CA, Various entry ramps	1	0.1	When demand warrants	HOV 2+	No
Denver, CO, US 36 (Boulder Turnpike)	1 (EB)	4.1	6-9 am	Buses	No
Honolulu, HI, H-2	1 (SB)	0.8	6-8 am, 3:30-6 pm	HOV 2+	No
Minneapolis, MN, Various entry ramps	1	0.2	Peak periods	HOV 2+	No

Table H-2 Operational Characteristics of Selected Freeway/Expressway HOV Facilities as of Janurary 1994

HOV Facility	# Lanes	Length (miles)	Hours	Eligibility	Rule changes?
Fort Lee, NJ (NYC), I-95	1 (EB)	1.0	7-9 am	HOV 3+	No
Seattle, WA					
SR 509	1 (NB)	0.8	24 hours[1]	HOV 2+	No
SR 526	1	0.5	24 hours	Buses	No
Various entry ramps[2]	1	0.1	Peak periods	Mostly HOV 2+	No
Ferry terminal docks	1	0.1	24 hours	HOV 2+	No

1 Seven-day week; all others are five-day week
2 Included are 23 metered ramps and 20 non-metered ramps

Source: Transportation Research Board, HOV Committee.

Table H-3 Listing of Proposed Major Freeway/Expressway HOV Facilities as of January 1994

	Length (miles)	Lane-miles	Anticipated Opening
Arizona, Phoenix			
Route Loop 202 (East Papago Freeway)	9.0	18.0	1992
I-10, extensions to concurrent-flow, buffer-separated lanes	8.0	16.0	1992-95
British Columbia, Vancouver			
H-7 (Barnet Highway), concurrent-flow lanes	6.0	NA	1993
Trans Canada Highway, concurrent-flow lanes	12.0	NA	Late 1990s
California, Bay Area			
US 101 (San Jose), extension to concurrent-flow lanes	7.0	14.0	1993
I-80/580, concurrent-flow lanes	NA	NA	Late 1990s
I-80 (Contra Costa), concurrent-flow lanes	35.2	70.4	Staged thru 1998
US 101 (Marin), extension to concurrent-flow lanes	3.0	6.0	Late 1990s
I-880 (Alameda), concurrent-flow lanes	NA	NA	Late 1990s
SR-4 (Contra Costa), queue bypass	0.5	0.5	1993
I-880 (Santa Clara), concurrent-flow lanes	10.0	20.0	Late 1990s
SR-237 (Santa Clara), concurrent-flow lanes	15.0	30.0	Mid 1990s
SR-85 (Santa Clara), concurrent-flow lanes	16.0	32.0	1994
SR-101 (Santa Rosa), concurrent-flow lanes	3.0	6.0	Late 1990s
California, Los Angeles			
I-10 (San Bernandino), extension to concurrent-flow lanes	20.2	40.4	1999-2022
I-10 (Santa Monica), concurrent-flow lanes	9.3	18.6	2020
I-110 (Harbor), transitway and ramps	14.0	41.0	1995-2011
I-710 (Long Beach), concurrent-flow lanes	23.0	46.0	2006-2024
I-405, concurrent-flow lanes	49.0	98.0	1993-2002
I-605, concurrent-flow lanes	20.0	40.0	1996-1997
I-5, concurrent-flow lanes	45.6	91.2	Staged 1999-2018
SR-2, concurrent-flow lanes	4.6	9.2	2004
SR-14, concurrent-flow lanes	36.0	72.0	1997-2002
SR-30, concurrent-flow lanes	8.3	16.6	1997-1999
SR-60, concurrent-flow lanes	30.0	60.0	Staged 1996-2006
SR-91, westbound concurrent-flow lane	14.0	18.0	1994
US 101, concurrent-flow lanes	37.0	74.0	2009-2024
SR-118, concurrent-flow lanes	11.4	22.8	1996
SR-134, concurrent-flow lanes	13.0	26.0	1995
SR-170, concurrent-flow lanes	6.1	12.2	1995

Table H-3 Listing of Proposed Major Freeway/Expressway HOV Facilities as of January 1994

	Length (miles)	Lane-miles	Anticipated Opening
California, Orange County			
I-5, concurrent-flow lanes	36.0	72.0	1995-99
I-5, barrier-separated lanes	3.3	12.0	1996
Routes 55/405, 57/91, and 55/91, HOV interchanges	6.0	13.0	Mid/late 1990s
SR-91, concurrent-flow lanes	19.0	38.0	1994
California, San Bernandino County			
I-10, concurrent-flow lanes	10.0	20.0	1999
SR-60, concurrent-flow lanes	10.0	20.0	1996
SR-71, concurrent-flow lanes	8.0	17.0	Mid/late 1990s
SR-30, concurrent-flow lanes	22.0	44.0	Late 1990s
I-215, concurrent-flow lanes	4.0	8.0	
California, Riverside County			
SR-60, concurrent-flow lanes	20.0	39.0	Planning studies
SR-91, concurrent-flow lanes	11.0	21.0	Planning studies
I-215, concurrent-flow lanes	7.0	15.0	Planning studies
California, Sacramento			
Route 99, concurrent-flow lanes	11.0	22.0	1993
California, San Diego			
I-5, concurrent-flow lanes	21.0	42.0	Late 1990s
I-15, concurrent-flow lanes	12.0	24.0	Late 1990s
Colorado, Denver			
I-25, reversible-flow lanes and ramps	12.0	18.0	1995
Connecticut, Hartford			
I-84, WB concurrent-flow lane	1.5	1.5	1996-98
Florida, Fort Lauderdale			
I-95, concurrent-flow lanes	29.0	58.0	Beyond 2000
Georgia, Atlanta			
HOV lane conversions on I-85, I-75	58.0	116.0	1995-1996
Illinois, Chicago			
I-55 (Stevenson Expy.), concurrent-flow lanes and ramps	13.0	26.0	1998-99
Maryland			
I-270, concurrent-flow lanes	12.0	24.0	Mid/late 1990s
SR-141, concurrent-flow lanes	NA	NA	Late 1990s

Table H-3 Listing of Proposed Major Freeway/Expressway HOV Facilities as of January 1994

	Length (miles)	Lane-miles	Anticipated Opening
Massachusetts, Boston			
I-90, concurrent-flow lanes	1.0	1.5	Late 1990s
I-93 south, contraflow lane	6.0	12.0	1994
I-93 north, concurrent-flow lanes	0.5	0.5	Late 1990s
I-93 south, concurrent-flow lanes	5.0	10.0	Late 1990s
Minnesota, Minneapolis			
I-35W, concurrent-flow lanes	17.0	35.0	1994-1996
I-94, concurrent-flow lanes	35.0	70.0	Late 1990s
New York			
I-495 (Long Island Expy), concurrent-flow lanes	23.0	46.0	1995-99
I-287 (Cross Weschester Expy), concurrent-flow lane	5.0	10.0	Mid 1990s
Gowanus Expressway, concurrent-flow lanes	5.0	10.0	Mid 1990s
New Jersey, Morris County			
I-80, concurrent-flow lanes	11.0	21.0	1994
I-287, queue bypasses, concurrent-flow lanes	21.0	42.0	Staged 1996-1998
North Carolina, Charlotte			
US 75, reversible-flow lane	3.3	3.3	1998
Ontario, Toronto			
H-403, concurrent-flow lanes (outside)	1.0	2.0	Mid 1990s
H-403, concurrent-flow lanes (median)	5.0	10.0	Late 1990s
H-401, H-404, H-427, concurrent-flow lanes	Varies	Varies	Late 1990s
Ontario, Ottawa			
Extensions to busway system	5.0	10.0	Staged thru 2000
Concurrent-flow freeway bus lanes	NA	NA	Mid 1990s
Pennsylvania, Pittsburgh			
Airport Busway	8.0	16.0	Mid 1990s
Pennsylvania, Philadelphia			
I-95, reversible-flow lanes	13.0	26.0	Beyond 2000
Texas, Dallas			
I-635, concurrent-flow lanes	7.0	13.0	1995
I-35E, concurrent-flow lanes	8.0	15.0	Late 1990s
I-35E, US 67, contraflow lane, reversible ramps	8.0	12.0	Mid 1990s
I-30, contraflow lanes	3.0	6.0	Late 1990s

Table H-3 Listing of Proposed Major Freeway/Expressway HOV Facilities as of January 1994

	Length (miles)	Lane-miles	Anticipated Opening
Texas, Houston			
US 59 (Southwest), reversible-flow lane	2.0	2.0	1996
US 59 (Eastex), reversible-blow lane and ramps	20.0	20.0	Staged 1995-2000
I-45 (North), extension to reverrsible-flow lane	6.2	6.2	Late 1990s
I-45 (Gulf), extension to reversible flow lane	4.0	4.0	Mid 1990s
Virginia, Norfolk/Virginia Beach			
I-64, reversible flow lanes	10.0	20.0	Mid 1990s
I-264, concurrent-flow lanes	4.0	8.0	1996
Route 44, concurrent-flow lanes	10.0	20.0	Mid 1990s
Virginia, Washington DC Area			
I-95, extension to reversible-flow lanes	19.0	38.0	Mid 1990s
I-66, concurrent-flow lanes	7.5	15.0	Mid 1990s
I-95/495 Capital Beltway	20.0	40.0	1998 thru 2010
Washington, Seattle/Tacoma/Everett			
I-405, extensions to concurrent-flow lanes	22.0	44.0	Staged thru 2000
I-5 south, extensions to concurrent-flow lanes	22.0	40.0	Staged thru 2000
I-5 north, concurrent-flow lanes	13.0	22.0	Staged thru 2000
I-90, concurrent-flow lanes[1]	7.0	7.0	1994
SR-520, concurrent-flow and reversible lanes	5.0	10.0	Staged thru 2000
SR-525, extensions to concurrent-flow lanes	3.0	6.0	Staged thru 2000
SR-167, extensions to concurrent-flow lanes	13.0	26.0	1996
SR-16, concurrent-flow lanes	15.0	30.0	Staged thru 2000
SR-526	1.0	1.0	2000

[1] Two miles of lane conversion opened. Remainnder of project may also be converted lanes.

Source: Transportation Research Board, HOV Committee.

APPENDIX I

LIGHT

RAIL

TRANSIT

Appendix I

Light Rail Transit

Contents

Tables

Appendix I Light Rail Transit

This appendix describes light rail transit and discusses the issues related to planning for this mode of transportation.

Light rail transit is an evolution of the trolley or streetcar of the late nineteenth and early twentieth centuries. The trolley provided commuter and other travel service for those who lived in urban areas as well as the subdivisions being developed at the edges of the cities. In several cases, streetcar lines were constructed by land developers to provide access to the subdivisions they were developing. These streetcar suburbs were prevalent in the 1920s prior to the Depression. For instance, the Shaker Rapid, still in operation, was built in the late 1920s as part of the development of the Shaker Heights subdivision outside of Cleveland.

In the late 1970s there was a resurgence of interest in streetcars to provide an alternative to automobile commuting. Several cities planned and built new streetcar lines, referred to as Light Rail Transit (LRT) to differentiate them from Heavy Rail Transit lines, including subways, which were built during the 1970s.

A. What is Rail Transit Service?

There are three basic types of rail transit service:

- **Heavy rail** transit provides the highest level of service in terms of frequency of service, speed and, therefore, passenger volume. Generally, heavy rail lines are located in a radial pattern to serve the employment, retail, and entertainment activities in a central city. Heavy rail service operates on a separate right-of-way and with stations spaced at approximately 1 mile apart, or a 1/2 mile in urban areas. Heavy rail lines are often built underground as subways, although some have portions of their alignments on the surface as well as elevatoed over roadways or other rights-of-way. Since they possess exclusive rights-of-way, heavy rail trains can run as frequently as every three minutes in each direction. The Washington Metro and the Baltimore Subway are local examples of heavy rail transit service.

- **Commuter rail** service connects outlying suburban and exurban areas to central city employment areas. Commuter rail lines often use the same tracks as longer distance passenger and freight rail service. The service is less frequent than other rail transit, often with 30 minutes or more between trains. The service extends further from the central city, and the stations are also spaced further apart. As most

people have to arrive at the station by car or bus due to the station spacing and the typically low density residential development, parking lots and bus bays are provided. The three MARC lines (Brunswick, Camden, and Penn) serving Union Station in Washington, D.C., are local examples of commuter rail service.

- **Light rail** transit provides service at lower frequency, speed, and passenger volume than heavy rail. As with heavy rail transit, the service historically has been from suburban centers to a central city, but several new systems are planned to connect suburban centers to each other. This service often provides connections to heavy trail transit if such service is present. Light rail lines are generally located on the surface except where grade-separated crossings are necessary. The alignment may be on an exclusive right-of-way or in the street.

In cases where the alignment is in mixed traffic, delays can occur due to both the turning movements of the other vehicles and the need to obey traffic signals. Outside the urban area, gates are used at road intersections to keep cross traffic off the tracks when light rail trains are nearing the intersection. The stations are normally spaced closer than heavy rail stations. These factors keep the speed of light rail trains to approximately 20 miles per hour when stops and other delays are taken into account. Service on light rail transit lines can be as frequent as every five minutes during the peak periods. The Baltimore Central Light Rail Line is a local example of light rail service.

Suspended light rail is a form of light rail that, as the name suggests, is suspended from a solid beam which forms the track. Columns support the beams along the alignment. The stations are elevated to the height of the cars. As the cars are suspended, there are no delays due to conflicting movements. The facility's suspended nature also significantly reduces the extent of environmental and community impacts created by constructing and operating such a service. Although there are no examples providing commuter service in urban areas in the United States, there are examples in Japan and Germany, and there are limited-service lines at the Dallas-Fort Worth Airport and at some corporate office parks. Montgomery County is a finalist in a competition for a demonstration grant for a suspended light rail line. This line will provide service from the Grosvenor Metro station, through the Rock Spring Park Corporate Center, to Montgomery Mall where a bus transit center and park-and-ride lot already exist.

Table I-1 compares the design criteria and performance characteristics of heavy rail, light rail, and suspended light rail transit, and includes busway and HOV characteristics for comparison. Table I-2 compares the operating characteristics of nearly two dozen existing light rail lines in the United States and Canada.

B. How Should the Success of Light Rail Transit Service be Measured?

Ridership is often seen as the measure of success. This is understandable as it is easily determined and because it has a direct relation to the extent the transit line is subsidized. However, ridership is a limited perspective on the success of light rail service.

Light rail transit assists in supporting several policies related to transportation, land use patterns, and the environment:

Accessibility

Rail transit service increases accessibility for residents and employees in the community during the peak commuting periods, as well as during the day, evenings, and weekends. The non-commuting service is especially important to those who, due to age, financial constraints, physical conditions, health, or other factors, do not drive.

Maintenance of Established Centers

Focusing transit service on existing centers can augment the office and retail market strength of the real estate located within walking distance of transit stations. The stations increase the number of people entering and leaving the area. With the provision of light rail transit, the potential exists to increase density and mix of uses within walking distance of the stations.

In areas where there is capacity for additional development, the presence of a transit station can increase the market potential of the adjacent property. In many cities, the construction of rail transit service has been connected to the subsequent increase of office, retail, and residential development. Bethesda and Silver Spring are local examples of where such development has occurred. Several shop owners in the station areas of the Baltimore Central Light Rail Line have noticed an increase in business from customers using the rail line.

Any change to expand the amount and mix of development permitted by the area master plan is a local land use planning decision and beyond the scope of this functional Master Plan. If appropriate, concentrating land use of activities within walking distance of a station, rather than in outlying areas, would have the benefit of increasing the number of potential riders, reducing the number of those who would need to drive, and reducing the number of auto trips they would need to make. However, such changes can only be made by the area master plans.

Support Other Transit Facilities

Additional light rail service should increase total transit ridership, particularly on connecting lines. However, existing bus lines may need to be rerouted to optimize ridership on the total transit network. Transit lines should provide extensions to existing rail transit service to new areas and/or should increase the network of transit lines to increase accessibility for residents and employees in the region.

Environmental Benefits

The construction of a light rail transit facility will cause some direct environmental impacts. Streams often need to be crossed and trees will need to be removed. Since most rail alignments parallel existing roadways or other transportation facilities, stream crossings tend to be expansions of existing ones rather than entirely new crossings.

The environmental benefits are primarily indirect. Reductions in vehicular travel resulting from light rail transit reduces air pollution. Also, light rail transit is more energy efficient per passenger than auto travel, leading to a reduction in energy consumption.

The other primary benefit is to facilitate planned development in areas with existing transportation and other public facilities. Encouraging development in these locations reduces the negative environmental effects of low-density sprawl development. Further, focusing development along existing transportation corridors and in activity centers reduces the fiscal impacts of low intensity development in new areas.

C. What are the Issues that Should be Considered in Planning for Light Rail Transit?

Planning for rail transit alignments is different than conducting a project planning study to determine what technology to select, what level of service to operate, when to initiate service, and how to phase in the service. The preparation of a master plan to identify and protect rights-of-way for transit alignments requires looking further into the future than a project planning study does. However, the alignments should be those for which there is a reasonable expectation that when the project planning studies are conducted, the construction of a transit facility will be found feasible.

One primary element of feasibility is the cost-effectiveness of the service. The ability of the proposed transit service to achieve revenues that are approximately one-half of the anticipated operating costs is a major criterion. Ridership is an easily measured indicator of the success of a transit line, but one that is difficult to predict.

The decision of a person to ride on a light rail line is the result of considering several factors relative to the choices available and the purposes of the trip. These factors can be grouped into three areas: time, cost, and effort.

Time is relatively straight-forward: which method of travel is the quickest from the origin to the destination, including all of the other stops along the way?

Cost is more complex because while both out-of-pocket costs and total costs should be taken into account, out-of-pocket costs weigh much heavier than the total cost. (See Appendix H.)

Effort relates to the stress of traveling on a congested roadway and to the time it takes to find out about transit fares, routes, connections, and station/stop locations. Frequency of use reduces the effort required to use transit as one becomes more familiar with and confident in the system.

The results of the considerations of the factors in each of the three areas then need to be evaluated in relation to each other. Which is more important — time, cost, or effort? As the relative times between choices change — due to increased traffic congestion or the provision of additional transit service — so will the decisions as to what mode of travel to select. Similarly, as costs change for gasoline, parking, or transit fares, so will the decisions as to the mode of travel selected. The same is true of the comparative amount of effort required due to the extent of congestion, difficulty in finding convenient parking at the destination or at the transit station, or improvements in the ability to use transit service and to transfer between transit systems. It still comes down to what is more important to the person making the trip — time, cost, or effort. The modeling used in the preparation of this master plan takes into account the behavioral characteristics of the current transportation users. However, when forecasting for 2010, these attributes remain at a level equivalent to 1990 levels.

The intensity and mix of uses within walking distance of transit service also has an effect on ridership. If the number of people near the transit station is increased (usually through higher densities), more people can conveniently take advantage of transit service. The more people who live and work within walking distance of transit and the more destinations that can be reached by transit, the more people are likely to use the transit service.

Estimates have been made of the minimum number of residents and employees and the densities of those land uses that are needed to support light rail transit service. These estimates are based on existing rail transit services in the northeast of the United States and in Europe because transit services in those areas have been in existence long enough to conduct such studies. Density is a reasonable and important indicator in estimating ridership, but the behavioral factors discussed above are probably more important in determining the actual usage of the transit service. Still, staff made a concerted effort to assess the number of people within a one-quarter mile radius of each transit station to better estimate transit usage.

Also, several of the elements in the behavioral factors are responsive to policy changes, whereas changes in the density and mix of land uses take longer to achieve. For instance, the availability and cost of parking at employment centers can be changed by local legislation. Such an increase in out-of-pocket costs to commuters might result in an increase in the usage of transit by those traveling to those centers. (It should be recognized, however, that other responses to such a change, such as companies in those centers relocating to other jurisdictions, might also occur.)

Once an alignment corridor is found to be appropriate for protection, additional study is needed to more precisely identify the land required to be protected for the alignment, including stations, parking, and storage and inspection yards. Although detailed engineering and design is not appropriate at this time, engineering consideration is needed to assure that the alignment is feasible in terms of grading and environmental impacts and that the alignment considers cost implications, particularly in regard to such elements as the extent of elevated structures and stream crossings.

In particular, the planning for light rail transit alignments should consider the following factors:

Land Use Density and Mix at Stations

As noted above, stations should be located where significant numbers of people can walk between the station and jobs, retail opportunities, and/or housing. Locations at points of high vehicular accessibility are also appropriate if adequate park-and-ride facilities can be provided.

Access to Station

Even if significant numbers of people walk to and from the station, there will still be a demand for access to the station by cars and bus transit vehicles. Therefore, consideration should be given to locating most stations where parking and bus access facilities can be provided. The anticipated level of congestion on the roadways needs to be considered as high levels of congestion will inhibit vehicular access to the station.

Station Spacing

While frequently spaced stations will increase the number of people within walking distance of transit, it will also reduce the average speed of the trip as well as negate any time savings for those who travel longer distances. A balance needs to be reached between the two objectives.

Single, Dual, and Bypass Tracks

Light rail transit lines generally possess a single track in each direction. The second track can also be used to bypass a disabled train or accident, should one

occur. Having sections of an alignment with only one track significantly reduces the ability to increase the frequency of service since trains in the opposite direction need to wait until the other train clears the single-track portion of the alignment. If an alignment is long, another advantageous consideration may be express service. Express service would enable long-haul travelers to bypass local stations and achieve greater time savings. In order for express trains to function, a third (or bypass) track is needed for the express train to pass the local trains safely and not conflict with the trains in the opposite direction.

Noise Impacts

Light rail transit is electrically powered and is very quiet. Most noise associated with it is produced by the air conditioning units on the cars. The additional noises, such as bells or horns, are for safety purposes. In urban situations, the operators often have to get the attention of pedestrians and drivers because the trains are so quiet. At locations where the tracks cross a roadway, crossing gates with a bell and flashing lights to alert drivers are necessary. In addition, the operator may honk a horn as a further safety precaution.

The only other location where noise may be a concern is at locations with tight turns, such as the storage and inspection yards. New wheel carriages may create "wheel squeal" when they travel across turns at or near the minimum acceptable curvature. Proper engineering can minimize this impact.

At-Grade vs. Grade-Separated Crossings of Roadways

At-grade crossings are where the tracks cross a roadway at the same level. In these situations, the traffic on the roadway is stopped while the train passes the intersection. A grade-separated crossing is one in which the tracks or the roadway are elevated (bridge) or depressed (tunnel) in relation to the other. The construction of a grade-separated crossing is more expensive but provides quicker service than an at-grade corssing. The decision should take into account the effect of the delay caused by the trains, which is related to the frequency of service on the transit line, and the volumes on the roadway. The costs of such delays should be compared to the cost of constructing a grade-separated crossing.

Storage and Inspection Yards

Facilities need to provide for the storage of vehicles when they are not in use as well as for the inspection, cleaning, and repair of the vehicles. This is a light industrial use similar to a warehouse. Selecting a site of appropriate size and location can be a difficult task. From an operational perspective, the storage and inspection yards should be located near an end of the line. Adequate noise and visual buffering should be provided between the system and sensitive adjacent uses.

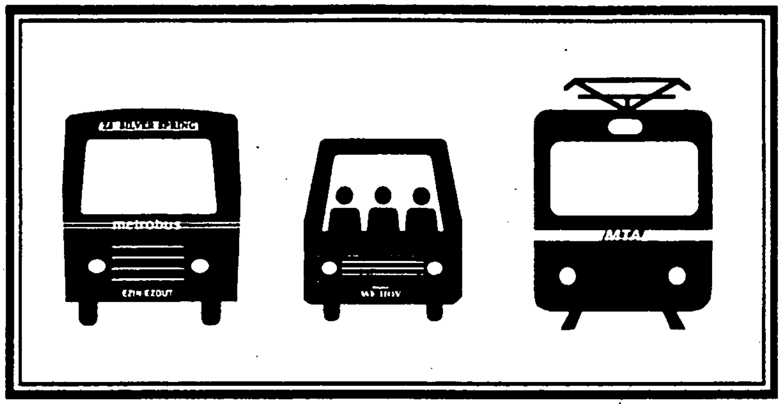
Table I-1 Comparison of Design Criteria and Performance Characteristics

	Heavy Rail Transit (WMATA Metrorail)	Light Rail Transit (Baltimore Central LR and Corridor Cities)	Suspended Light Rail Transit (N. Bethesda TransitWay)	Busway	HOV
VEHICLES					
length	75 ft	95 ft	24 ft	40 ft	varies
width	10 ft	9.5 ft		8.5 ft	varies
height (above rails/road)	11 ft	12.5 ft			varies
seats/vehicle	80	85	48	48	varies
total passengers (normal)	155	173	155	73	varies
total passengers (crush)		261	186		N/A
TRAINS					
vehicles/train	2-8	1-3	1	1	1
at grade crossings?	No	Yes	No	Yes	Yes
max speed	75 mph	55 mph	60 mph	70 mph	55 mph
min turning radius	775 ft	82 ft	250 ft	46 ft	
max grade	4%	8%	6%	6%	
power supply	electric third rail	overhead catenary	electric traction	gas, diesel, electric	gas, diesel, electric
vertical clearance (above rails/road)	15 ft	15 ft	17 ft (below)	14.5 ft	14.5 ft
catenary height	N/A	13.5-22.0 ft	N/A	N/A	N/A
min r-o-w for 2-track mainline or one traffic lane	30 ft	29 ft	46 ft	12 ft	12 ft
STATIONS					
platform length	600 ft	300 ft	100 ft	90 ft	N/A
platform width	30 ft	10-15 ft	25 ft	10 ft	N/A
min spacing (not urban area)	1 mile	0.25 mile	0.33 mile	N/A	
min r-o-w at station	46 ft (center)	43 ft (center)	50 ft (center)	26 ft	N/A
CAPACITY					
policy headway	3 min	4 min	12 min	0.7 min	0.03 min
min headway	2 min		6 min		
trains/hour	20	15	10	84	
vehicles/hour	160	45		90	2,000
peak hour person capacity	24,800	7,785	3,260	6,570	varies
FARE COLLECTION	ticket machine/fare gate	ticket machine/honor system	coin/token gates	fare box on bus	N/A

Table I-2 Operating Characteristics of Light Rail Transit Lines in the United States and Canada

City/Line	Opening Year	Length (miles)	Number of Vehicles in Service	Seating/Crush Capacity of Vehicles	Minimum Peak Headway (minutes)	Weekday Ridership	Avg. Operating Speed Including Stops (mph)
Baltimore/Central Lt. Rail	1992	22.5	35	85/261	15.0	19,000	
Calgary/C-Train[1,2]	1981	18.2	85	64/200	6.0	114,500	20
Cleveland/Shaker Rapid[1]	1920	13.5	48	84/160	10.0	12,080	21
Edmonton/Northeast LRT[1,3]	1978	6.5	37	64/226	5.0	23,400	19
Los Angeles Long Beach/Blue Line[2,3]	1990	21.6	54			35,000	
Newark/City Subway[3]	1935	4.3	24			14,000	
Philadelphia/Media-Sharon Hill[1]		11.9	29			9,600	
Portland/MAX[1]	1986	15.1	26	76/256	3.0	23,800	20
Sacramento/RT Metro[1]	1987	18.3	36	64/175	15.0	23,500	19
St. Louis/MetroLink[4]	1993	18.0	31		7.5	25,000	
San Diego/[1]	1981	33.2	71	64/200	7.5	52,000	23
San Jose/Guadalupe[1]	1991	22.0	50	75/210	10.0	18,000	19
Boston/Green Line[1,2]	1889	24.9	194	52/140	1.2	189,000	14
Boston/Mattapan-Ashmont		2.7	12			7,000	
Buffalo/Metro Rail[1]	1985	6.4	27	51/210	5.0	30,000	18
Ft. Worth/Tandy[3]	1962	1.0	8			6,500	
Philadelphia/Subway-Surface[1]	1987	22.3	112			49,700	
Pittsburgh/South Hills[2]	1987	22.5	102			34,000	
San Francisco/Muni Metro[3]	1989	20.1	141			134,000	
New Orleans/St. Charles[3]	1893	6.5	50			21,000	
Philadelphia/Streetcars[1]		57.4	110			51,300	
Toronto/Streetcars[3]	1892	45.6	275			330,000	

Sources:
[1] "Light Rail in North America (Part I)," Urban Transportation Monitor. May 1, 1992, pp. 8-9.
[2] "Light Rail in North America (Part II)," Urban Transportation Monitor. May 15, 1992, pp. 9-11.
[3] Light Rail Transit. American Public Transit Association, 1987.
[4] "New St. Louis LRT Shows Better Than Expected Ridership," Urban Transportation Monitor. September 19, 1993, pp. 1, 16.


metrobus
MTA

APPENDIX J

BUSWAYS

Appendix J

Busways

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Appendix J Busways

A. What Is a Busway?

Generally, a busway is a roadway set aside for bus use only. More specifically, a busway can take one of two forms:

- Bus lane: a lane reserved for buses in a roadway's right-of-way. The buses can flow in the same direction as traffic (bus lane), or in the opposite direction (contraflow lane). The lane is separated by a stripe or barrier to keep general use traffic out, and can be reserved for buses during part or all of the day. Bus lane examples: Boulder Turnpike (US 36) in Denver has a four-mile stripe-separated lane operating in the peak direction in the morning only; bus lanes are also designated in Los Angeles, New York City, and Ottawa. Contraflow lane examples: Lincoln Tunnel between New Jersey and New York; eastbound Fifth Avenue in Pittsburgh.

- Exclusive facility: a separate right-of-way reserved for the uses of buses only. It can parallel a roadway but it is not necessary. Examples: East Busway in Pittsburgh; Ottawa-Carleton Transitway System in Ottawa, Ontario.

Since all HOV facilities allow buses in addition to car/vanpools, every HOV facility in the country can also be considered a busway. However, HOV lanes can become as congested as the general-use lanes they were designed to relieve, slowing bus travel in the process. As noted in Appendix H, HOV lanes can be stripe or barrier-separated and may be reversible as well. A local example of such a shared HOV facility is the Shirley Highway (I-395) in Virginia, where the 4,750 carpools move only slightly more people than the 440 buses during the morning peak period (18,900 versus 15,300). See Table J-2 at the end of this appendix for other ridership numbers of existing facilities.

The facilities discussed in the Transitway and High-Occupancy Vehicle Network Master Plan are primarily exclusive busways and this appendix focuses on them. Shared bus/HOV use is covered in the HOV analysis. The other option — either a contraflow or bus lane — were generally not studied as a part of this process.

B. How Does a Busway Work?

The two exclusive right-of-way busway systems in North America — in Pittsburgh, Pennsylvania and Ottawa, Ontario — work in much the same fashion. The nature of busways makes them very flexible, limited only by planning ingenuity, physical constraints, and the existing patterns of travel. Busways are currently used in any combination of the following three ways:

- Station-to-station: Buses simply travel up and down the busway and stop at each station, similar to a rail vehicle with similar headways, speeds, and capacities.

- Express: Buses provide express service, collecting passengers throughout neighborhoods and at central gathering points (shopping centers, park-and-ride lots) before entering the busway. The express buses in Pittsburgh and Ottawa do not stop once they enter the busway, providing quick non-stop service to the busway's terminus from outlying residential areas.

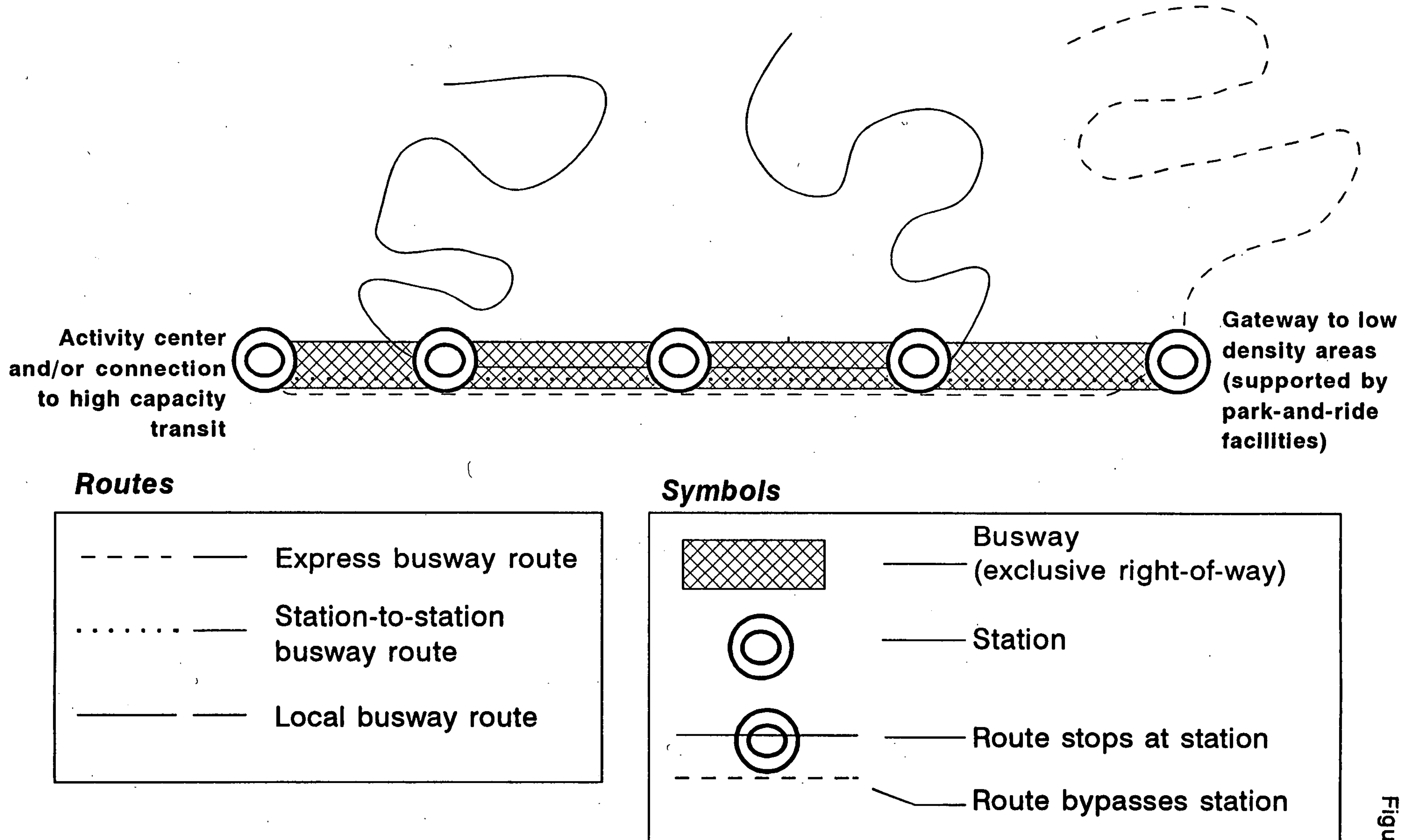
- Local: Buses circulate throughout neighborhoods and either feed the busway without entering it or enter the busway and stop at a variable number of stations. Unlike Express and Station-to-station service, Local buses can leave the busway at any station, using the busway to bypass a congested stretch of roadway. Primarily geared toward non-central business district (CBD) travel. Local service supports more than justifies the busway.

A busway can use any or all three of these modes of operation, concentrating resources on the mode most appropriate for the land use patterns surrounding the busway. For instance, station-to-station service with very low headways (two to three minutes) might be more desirable in an area where development has concentrated in several areas suitable for busway stations as opposed to an area of relatively uniform low density. The two most heavily used modes on existing busways are Express and Station-to-station. These different modes are seen in Figure J-1.

C. How Do Existing Busways Work?

The alignments on which the exclusive busways in North America were placed were also considered for light rail transit, and much of the public relations effort regarding busways by both transit agencies has been toward defending their choice of a busway versus a light rail system.

Busway Operations



Passengers can also take advantage of the busway by local buses that do not access the busway, or by walking/bicycling/driving to a station.

Figure J-1

Pittsburgh Busway Experience

Pittsburgh currently has two busways, the South Busway and the East Busway (Map J-1); an additional busway in under current study that would extend seven miles west of the CBD to Pittsburgh International Airport. Both existing busways are run by the Port Authority Transit (PAT) arm of the Port Authority of Allegheny County. The more typical and heavily used East Busway will be the primary focus of this discussion.

Pittsburgh is somewhat unusual by modern urban standards regarding the ratio of jobs-to-households in its CBD; this concentration has a strong influence on the region's commuting patterns. While almost 140,000 people work in the 400-acre downtown each day, very few people live there. The downtown is also geographically confined by the Allegheny and Monongahela Rivers to the north and south, respectively, which come together at the downtown's westernmost point to form the Ohio River. In addition, the southern bank of the Monongahela is marked by towering hills and very steep slopes, constraining the number of entry points into downtown Pittsburgh from the south and west. The main road from the east bottlenecks at a tunnel approximately four miles from the CBD. The geography and employment concentration combine to make a very predictable commuting pattern, and while some suburbanization of jobs is occurring, it is not nearly as marked as in the suburban Washington, D.C. area, such as Montgomery County.

South Busway

The South Busway is four miles long and carries approximately 15,000 passengers per day. As noted by Kain et al., "It was built to bypass severe congestion at the Liberty Tunnel, the major roadway link between the Pittsburgh CBD and the South Hills Area." (p. 6-7) To do so, PAT equipped the adjacent light rail tunnel to accommodate buses as well as the light rail vehicles. It also provides a significant time savings by avoiding congestion on the roadway leading to the tunnel (Route 51). The time savings on the South Busway amounts to approximately 15 minutes per trip from the previous service on Route 51.

The South Busway is different from the East Busway, as well as the busway system in Ottawa, in that it has no stations. Therefore, the only type of buses operating on it are Express. This design is in response to the type of development along the Route 51 corridor: strip development shopping centers and large-lot residential subdivisions separated from other land uses. To allow routes from different areas easier access to the busway, four ramps were constructed south of the Liberty Tunnel. Unlike the East Busway, no new routes were created with the busway's opening. Instead, all routes using Route 51 were simply re-routed. Engineering and construction costs were kept relatively low by building the busway parallel to existing railroad tracks on a flat grade, and by designing the busway without stations, maintenance costs were also kept low.

East Busway

The East Busway runs approximately 6.8 miles from the Pittsburgh CBD to the suburb of Wilkinsburg and the entire facility runs alongside two railroad tracks owned by Conrail. Originally, four tracks existed in the right-of-way, but after discussions with Conrail, PAT bought the land of two of the four tracks for the East Busway, rebuilding and modernizing Conrail's system in the process. While this was made possible by the relative inactivity on the tracks, it is promising to note the co-operation involved between the transit agency and a private company. It is also worth noting that a substantial portion of the cost of the East Busway included upgrading the Conrail tracks as well as rebuilding several of the bridges over the busway and the tracks.

Ridership on the East Busway is approximately 31,000 on an average weekday. The busway provides a substantial time savings for its patrons: implementation of the East Busway reduced travel times for buses in the corridor by 20 to 30 minutes. All but one of the 31 PAT bus routes that use the busway go to the Pittsburgh CBD. The remaining route serves Oakland, home of several universities and hospitals several miles east of the CBD.

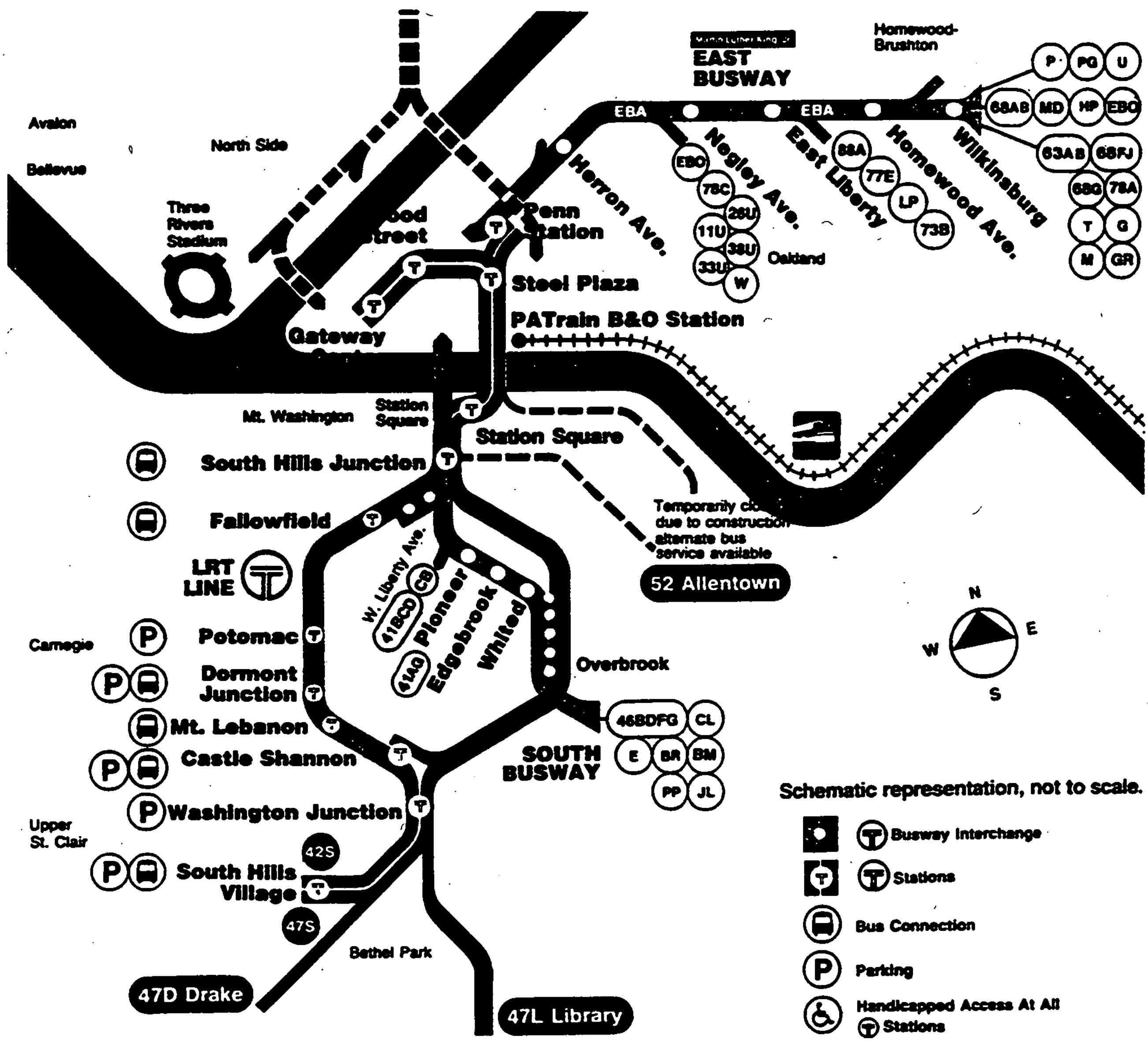
Approximately one-third of the ridership on the East Busway comes from one bus route, East Busway All Stops (EBA), that is similar to a light rail line, using 154 articulated buses throughout the day to carry nearly 12,000 passengers. Most riders of the EBA and EBO (East Busway Oakland, which stops at all stations but bails out east of the CBD to serve the university district) routes walk to the station (62%), while the rest transfer from another bus (22%), park near a station (11%), or are dropped off at a station (5%) (Kain, et al., p. 6-18). The incidence of parking is somewhat low because no park-and-ride facilities are provided at any of the stations along the East Busway. Those who park at the stations do so along neighboring streets or in nearby parking lots at shopping centers.

Nearly all of the people who ride express routes walk to their bus stop (92%), with about 2% each parking at the stop, getting dropped off at the stop, or transferring from another bus. The high incidence of walking comes most likely from the fact that residents in lower density areas will simply drive the entire trip if they cannot easily and quickly walk to the bus stop. This emphasizes the necessity of carefully planned routes that minimize travel time while maximizing coverage.

The East Busway has six stations where buses can enter and exit the facility. They can also exit and enter at another location near Oakland. Most of the station platforms are 120 feet long and can accommodate two articulated buses; the other two stations have the highest capacity and include 240-foot platforms that allow four buses to board/alight at one time. The stations along the busway are fairly simple, providing cover and seating for those waiting on the next bus. The stations are below grade but uncovered, making them visible from the street. Steps and ramps provide access from the adjoining street and all are well lit at night.

Map J-1

South and East Busways in Pittsburgh



As mentioned previously, PAT plans to expand the busway network westward to Pittsburgh International Airport. Again, the light rail option was reviewed but determined to be more expensive than a busway. PAT plans one difference in operation, however, with the addition of park-and-ride lots at several of the westernmost stations, since land is more readily available there.

Ottawa Busway Experience

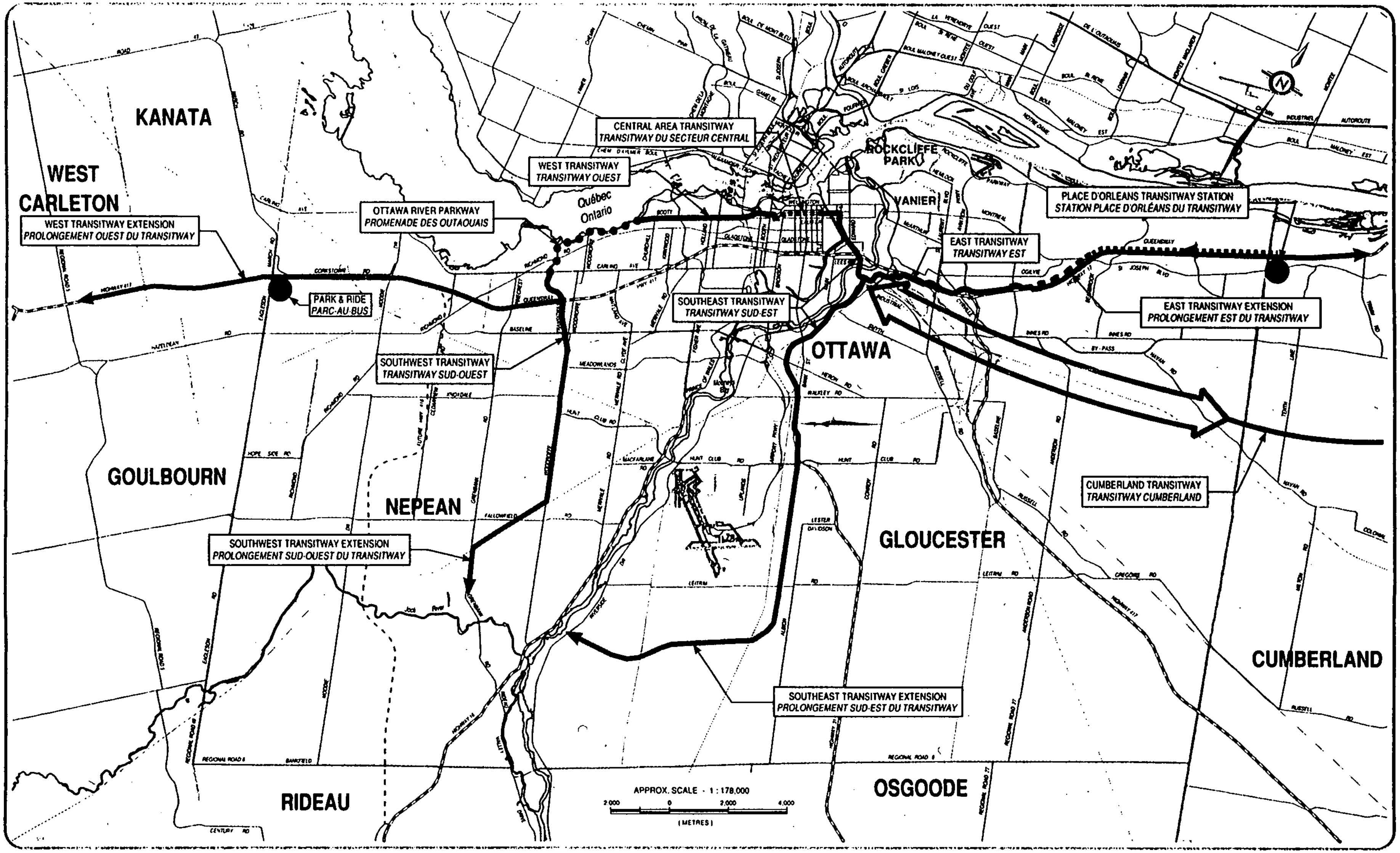
Planning for a transitway system in the Ottawa-Carleton area (Ontario Province) began with the mid-1970s coincidence of two trends: (1) a strong public sentiment against further freeway construction and (2) government's realization that they could never build sufficient roadways to accommodate growth. A study done in 1973 documented regional transit demand and validated the need for a high-capacity transit system (up to 15,000 passengers per direction in the peak hour). The question then turned to which mode would be most appropriate to meet this demand. According to John Bonsall of the Ottawa-Carleton Regional Planning Commission, "The busway alternative was selected due to lower capital operating costs, a higher level of service, and greater flexibility." (Turnbull (ed.), p. 17)

The transit authority in the Ottawa-Carleton area responsible for the Transitway is known as OC Transpo. Ultimately, a 43-mile system of exclusive busways and bus lanes was planned, branching from the CBD to the west, southwest, southeast, and east. Currently, nearly 25 miles of the system are in operation or are due to come on line within two years (Map J-2).

Geographically, the city is bordered on the north by the Ottawa River, with the cities of Hull and Gatineau on the other side of the river in Quebec. Montreal is approximately 80 miles due east. The Regional Municipality of Ottawa-Carleton (RMOC) in Ontario has nearly 700,000 people, nearly 620,000 of whom live within the urban transit area with the rest living in the rural area. Jobs in the Ottawa Central Business District (CBD) number nearly 75,000 and the total employment in the RMOC is approximately 340,000. The total number of jobs around Transitway stations is almost 110,000, including those in the CBD (Leech, 1994).

Ridership on the Ottawa Transitway is quite high, approximately 200,000 passengers on an average weekday. This figure is even more impressive when the size of the population is considered. While the Ottawa CBD has a very high share of work trips riding transit (with a modal split of above 60 percent), the CBD employment is only 22 percent of the total employment in the region. To increase the regional share of transit trips, it is necessary to increase the number of jobs near transitway stations.

Map J-2
Ottawa Transitway (Busway) Network



Ottawa-Carleton

Transportation Department - ***Service des transports***

1994

Transitway Programme

Programme du Transitway

LEGEND / *LÉGENDE*

- TRANSITWAY IN OPERATION
- BUS LANE IN OPERATION
- MIXED TRAFFIC OPERATION
- TRANSITWAY UNDER CONSTRUCTION
- FUTURE TRANSITWAYS

To this end, the busway system has been supported from the beginning with strong transit policies as well as a concerted and successful effort to channel most new development along its route. All new Primary Employment Centers (over 5,000 employees) must be located on the Transitway. Secondary Employment Centers can be located away from the transitway, but they must plan for dependable, all-day bus service to and from the Transitway. Furthermore, all shopping centers over 375,000 square feet must be on the Transitway or on planned future extensions of the Transitway. Subdivisions must also follow a rigorous set of guidelines that encourage transit use.

The operation of the Ottawa Transitway is similar to that of the East Busway in Pittsburgh. There are differences, however. For instance, express buses on Pittsburgh's East Busway do not stop once they access the busway. This reflects the concentration of jobs in the CBD. Ottawa express buses stop along the transitway if requested. They also stop at major transfer points, making suburb-to-suburb commuting much quicker. Since the busway accommodates travel in both directions, OC Transpo also runs reverse commute buses to serve center-to-suburb travel.

Other differences between the Pittsburgh and Ottawa systems include stations: on the Ottawa system, they are closer together and have more facilities (such as heated bus bays for passengers). In addition, park-and-ride lots exist at most Ottawa stations outside the CBD. These characteristics, coupled with the denser development focused around the stations, points up the treatment of the busway as a rail line. This runs contrary to the conventional wisdom that states that people will neither walk nor drive to ride a bus, which is seen as less appealing than a rail vehicle. Ottawa's experience proves differently: seven of ten downtown workers regularly use the bus, which might also arise from the appearance and comfort of the Ottawa buses.

D. Do Stations on Busways and Rail Lines Differ?

Stations on busways and rail lines (light, heavy, or commuter) differ significantly. In terms of design, they most resemble light rail stations in that they are normally not enclosed (with the exception of Ottawa due to its bitterly cold winters) and consist of several lines of benches, some covered.

Strategically, stations can differ significantly depending on the type of service desired. Of the three options listed above, concentrating on the first (Station-to-station) would, not surprisingly, make the stations more like a light rail line. This would include stations spaced closer together (approximately one-half to three-quarters of a mile apart) with park-and-ride lots at the stations near the end of the line. However, gearing the busway toward the second type of service (Express) would entail wider station spacing and enable planners to place the busway along less developed corridors as a connection between developed areas or even activity centers.

Further, the Express-oriented stations might not require the level of amenities and support of the stations geared toward pedestrians.

E. How Much Space Does a Busway Require?

Right-of-way for busways generally approximates that of a light rail line, and cross sections are seen in Figure J-2. The absolute minimum right-of-way required is 12 feet per lane, although the exclusive busways in Pittsburgh and Ottawa generally have seven to ten foot shoulders for safety purposes. As seen in the cross section, stations require more right-of-way since there needs to be room for express buses to bypass the station while another bus is loading/unloading passengers.

F. How Much Do Busways Cost?

As there are only two exclusive busway systems in North America at this time, a sufficient sample does not exist to give a reliable average cost per mile for exclusive busways. Table J-1 below presents the costs for the Ottawa Transitway, and the East and South Busways in Pittsburgh.

Table J-1
Cost per Mile of Existing Exclusive Right-of-Way Busways

Busway	Cost/mile[1]	Comments
Ottawa, Ontario		
Ottawa Transitway	$17.6	
Pittsburgh, Pennsylvania		
East Busway	$20.3	• $20 million for reconstruction of Conrail facilities (without: $17.3 million/mile)
South Busway	$9.4	• No stations were constructed

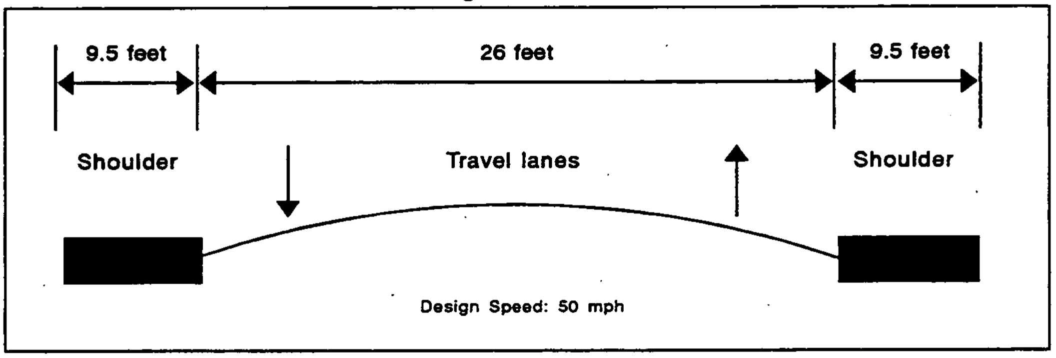
Source
Kain, John F., et al. 1992. Increasing the Productivity of the Nation's Urban Transportation Infrastructure: Measures to Increase Transit Use and Carpooling. (January) Prepared for the Federal Transit Administration, Washington, DC. US DOT #DOT-T-92-17.

[1] Millions of 1989 US dollars.

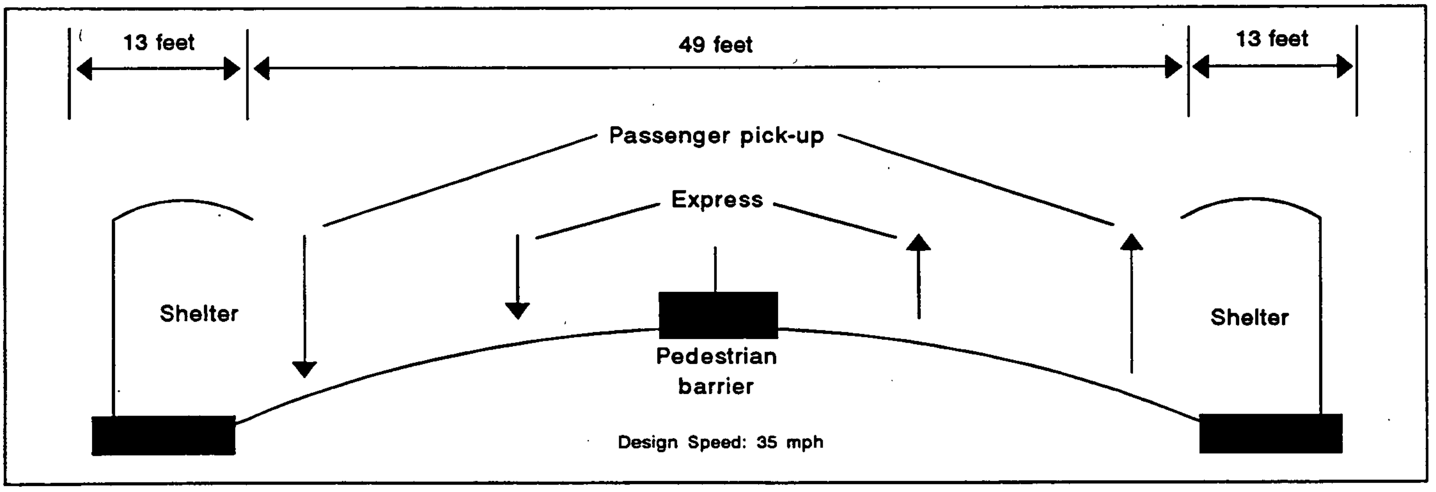
Figure J-2

Busway Cross Sections

Busway Main Line



Busway Station



Source: Bonsall, 1989b.

G. How Do Busways Affect Surrounding Development?

The ways in which busways can affect development depends almost entirely on the local government's policies in support of transit. The two systems provide a marked contrast in this respect.

As mentioned above, nearly all new development in Ottawa is concentrated along the busway. The fact that its stations are closer together, with an average distance between stations at three-quarters of a mile versus over one mile in Pittsburgh, means they depend more on passengers walking to the station for ridership. Ottawa's concentration on integrating the stations with surrounding development for support is also evidenced by the stations that are directly connected to adjacent developments such as a hospital and regional shopping center. Furthermore, the Regional Transit Commission has adopted "Transit First" policies that ensure land uses and patterns that support the busway. One example of this is the requirement that new regional centers be located along the Transitway.

Pittsburgh, however, has tried to make the busway stations as unobtrusive as possible. The only stations with significant dense development nearby are the downtown station and the East Liberty station. Even at East Liberty the high-rise residential development is over 1/3 mile away. Most of the stations are marked by a relatively small sign and, since they are below grade, it is easy to drive by without even knowing a station is there. It is doubtful that Pittsburgh will make an effort to encourage development around busway stations as Ottawa did, as the areas through which the busway travels are primarily built-out, mostly with townhomes, garden apartments, and low-intensity retail uses with some neighborhoods of single-family detached homes.

However, it should be noted that at the time of the East Busway's planning and construction, the land east of the city both vacant and easily accessible was exceedingly rare. The compromise struck by locating the busway along existing railroad tracks and through established neighborhoods precluded extensive redevelopment.

Table J-2
Bus Use of HOV Facilities Around the United States

City/Facility	Number of peak direction lanes		HOV Facility[1]					Non-HOV Freeway[1]			Length of Peak Period (hours)
			Bus		Van and Carpool			General Use			
	HOV	Freeway	Veh.	Pass.	Veh.	Pass.	Avg Occ	Veh.	Pass.	Avg Occ	
Bus only											
Ottawa, Ontario Canada											
Ottawa-Carleton Transitway	1	0	495	29,000	--	--	58.6	--	--	--	3
Pittsburgh, Pennsylvania											
South Busway	1	0	83	3,682	--	--	44.4	--	--	--	2
East Busway	1	0	145	9,065	--	--	62.5	--	--	--	2
New York City, New York											
Rt. 495 contraflow lane	1	3	1,640	65,600	--	--	40	17,435	29,120	1.7	4
Shared Bus/HOV											
Houston, Texas											
I-10 (Katy)	1	3	92	2,875	2,604	6,239	3.4	16,473	18,205	1.1	3.5
US 290 (Northwest)	1	3	33	940	2,598	5,450	2.4	16,360	17,363	1.1	3.5
Los Angeles, California											
San Bernardino Freeway	1	4	132	5,110	2,516	8,075	5.0	16,515	19,295	1.2	2
Washington, D.C./Virginia											
I-395	2	4	441	15,316	4,767	18,917	6.6	23,467	28,160	1.2	3
Los Angeles/Orange County California											
Rt. 55 Commuter Lane	1	3	5	70	2,371	4,977	2.1	10,009	10,691	1.1	2
I-405 Commuter Lane	1	4	7	160	3,173	7,171	2.3	16,384	18,002	1.1	2
Rt. 91 Commuter Lane	1	4	3	120	2,153	5,186	2.5	20,360	21,785	1.1	2
Seattle, Washington											
I-90	1	3	89	2,890	270	607	9.7	13,547	15,037	1.1	3
SR 520	1	2	92	3,690	393	1,191	10.1	6,252	6,877	1.1	2
I-5	1	4	146	5,810	841	2,062	8.0	20,721	25,350	1.2	3

[1] Measured during morning peak period. Length of period varies: see table.

<u>Source</u>

Turnbull, Katherine F. and Hanks, James W. 1990. <u>Description of High-Occupancy Vehicle Facilities in North America</u>. (July) Prepared for the Urban Mass Transit Administration, Washington, DC. US DOT #DOT-T-91-05.

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APPENDIX K

MASTER

PLAN

TRANSIT

RECOMMENDATIONS

Appendix K

Master Plan Transit Recommendations

Maps

Appendix K Master Plan Transit Recommendations

The following is a summary of the relevant transit and HOV recommendations from proposed and approved and adopted master plans, including:

Aspen Hill Master Plan (1994)

Bethesda CBD Final Draft Sector Plan (1993)

Bethesda-Chevy Chase Master Plan (1990)

Clarksburg Final Draft Master Plan (1993)

Eastern Montgomery County Planning Area Master Plan (1981)

Friendship Heights CBD Sector Plan (1974)

Gaithersburg Vicinity Master Plan (1985)

Georgetown Branch Master Plan Amendment (1990)

Germantown Master Plan (1989)

Glenmont Transit Impact Area Sector Plan (1978)

Kensington-Wheaton Master Plan (1989)

North Bethesda-Garrett Park Master Plan (1992)

Potomac Subregion Master Plan (1989)

Shady Grove Study Area Amendment(1990)

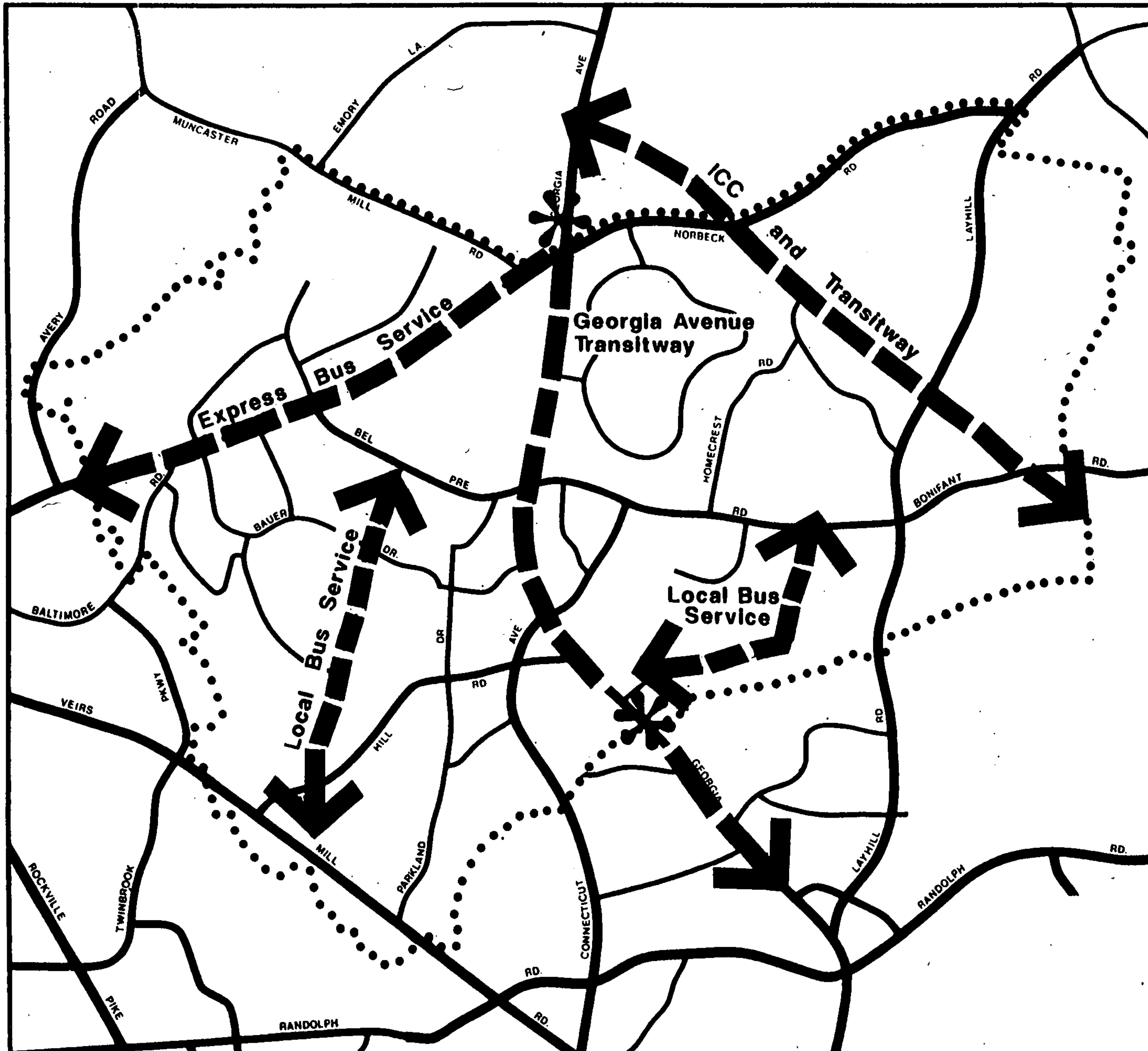
Silver Spring CBD Sector Plan (1993)

Wheaton CBD Sector Plan (1990)

ASPEN HILL MASTER PLAN (1994)

The transportation objective of the Aspen Hill Master Plan is to ensure a circulation system that minimizes the impact of traffic growth on residential communities in Aspen Hill, helps reduce auto-dependency, has sufficient transportation capacity for the land use recommendations proposed in the Master Plan, and is consistent with regional plans and policies. This plan assumes that the Intercounty Connector (ICC) will be constructed within the alignment of the right-of-way for the ICC shown on the 1970 Approved and Adopted Master Plan for Aspen Hill. Specific recommendations of the plan are as follows:

- expand bus service to provide coverage to neighborhoods where residents do not presently have safe and convenient access to the nearest bus line;
- provide feeder bus service from Aspen Hill to the Glenmont Metro station when service begins;
- construct a transitway in the median of Georgia Avenue between the northern and southern ends of the planning area;
- include bus lanes and perhaps carpool lanes within the Intercounty Connector (ICC) right-of-way when it is constructed;
- establish a transit assistance center in Aspen Hill to help reduce auto-dependency;
- any additional development or redevelopment of the Vitro site should include A rideshare program and enhanced transit service.



A Master Plan for the Communities of

Aspen Hill

Planning Area

PROPOSED PUBLIC TRANSPORTATION SYSTEM IMPROVEMENTS

LOCAL TRANSIT SERVICE

COMMUTER PARKING

NORTH

0 1000 2000 3000 FEET

0 1 2 KILOMETERS

FIGURE 35

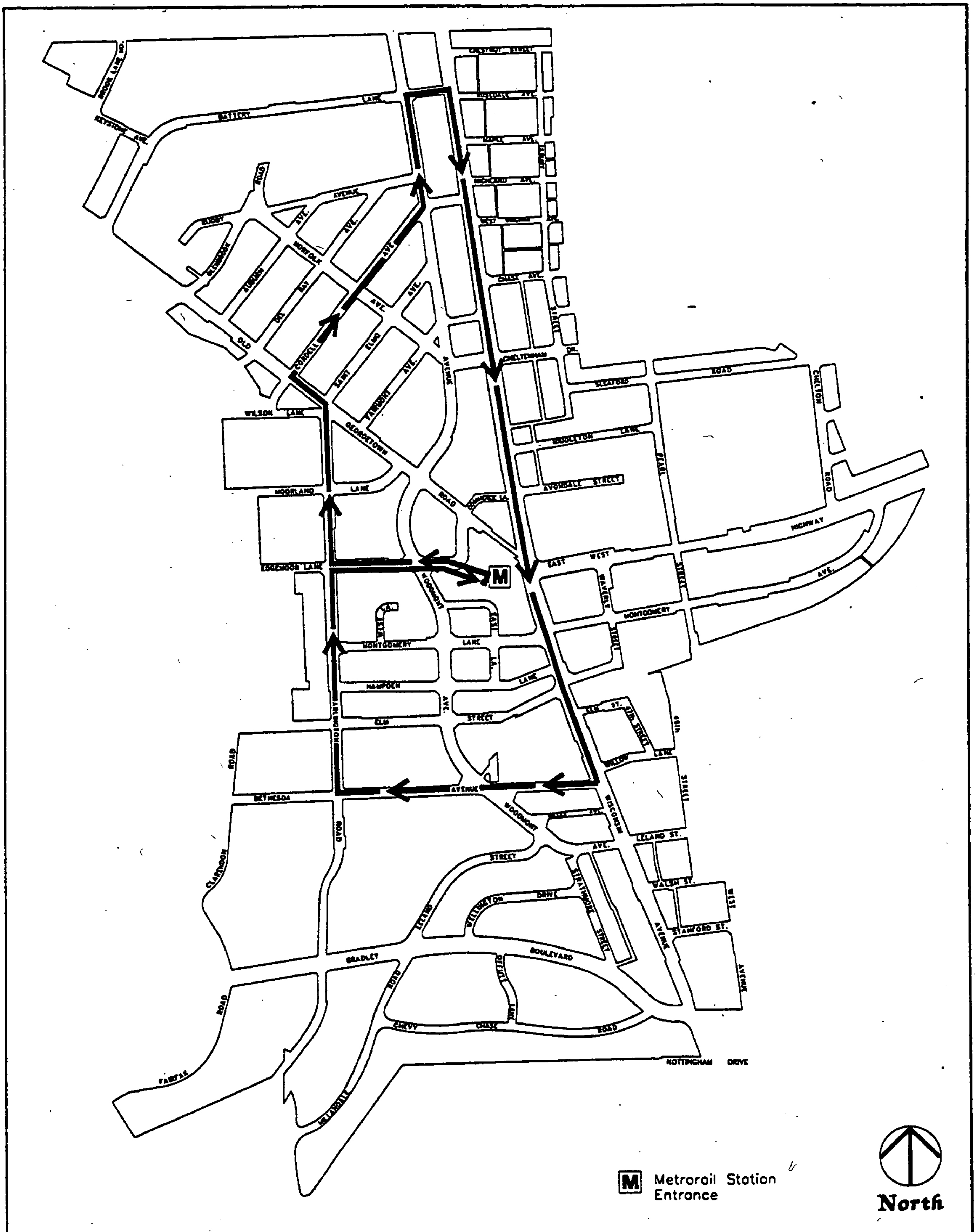
BETHESDA CBD SECTOR PLAN (1994)

The recommendations of the Bethesda CBD transportation plan are designed to increase the peak-hour commuter use of transit, carpools, bicycling, and walking by Bethesda CBD employees. These modes are not used to the extent they could be, so untapped capacity exists to support needed jobs and housing without creating additional traffic congestion. To this end:

- develop a Transportation Management District that employs techniques to increase the share of morning peak period work trips made by people using transit and carpools to existing and new jobs to 40 percent;
- expand bus service in the CBD, including the possible development of a shuttle bus loop for circulation;
- develop a light-rail connection to the Silver Spring CBD using the Georgetown Branch right-of-way, with a terminal located in the Bethesda Metro core. In addition, the Bethesda CBD plan recommends several alternatives for reaching the Metro core;
- institute a constrained parking policy to support the 40 percent transit and carpool use goal.

Conceptual Loop Bus Route

Figure 5.1



BETHESDA-CHEVY CHASE MASTER PLAN (1990)

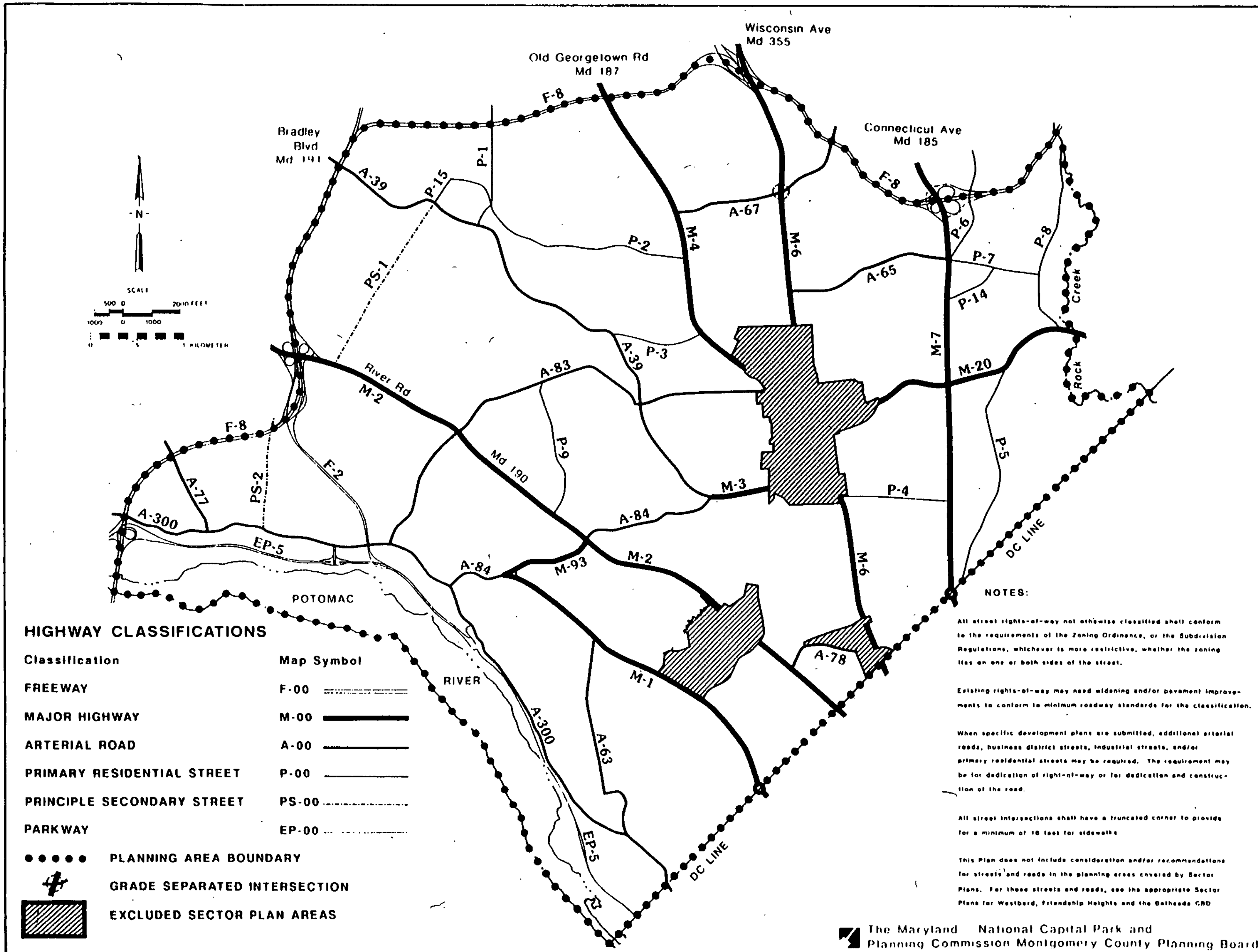
The Bethesda-Chevy Chase (B-CC) Master Plan's transportation goals are based on the assumption that "additional transportation service in B-CC should be based primarily on an expanded and vigorous program of transit." Specifically, the B-CC Plan recommends:

- two park-and-ride lots with approximately 750 spaces to be located at 1) I-495 and Kensington Parkway (250) spaces, and 2) A parcel, formerly a quarry, on River Road west of the fire station in the Potomac planning area (500 spaces);
- use of a personalized ridesharing program;
- a higher level of feeder bus service to Metro stations, as warranted;
- all existing and new development participate in the ridesharing service, encouraging the federal government to grant transit subsidies to their employees;
- Georgetown Branch right-of-way continues to be designated for light rail and trail use between the Bethesda and Silver Spring CBDs;
- for the *long term* (past the 20-year life of the plan), the B-CC Master Plan noted the need for the following improvements, under the strict stipulation that HOV use in the peak periods be a part of them:
    - an additional lane on Connecticut Avenue from the Georgetown Branch to Western Avenue;
    - an additional lane on Old Georgetown Road from I-495 to Huntington Parkway;
    - Widening Wisconsin Avenue from Cedar Lane to Woodmont Avenue to eight lanes.

Master Plan for the
Bethesda-Chevy Chase Planning Area
Montgomery County, Maryland

STREET AND HIGHWAY PLAN

Figure 13



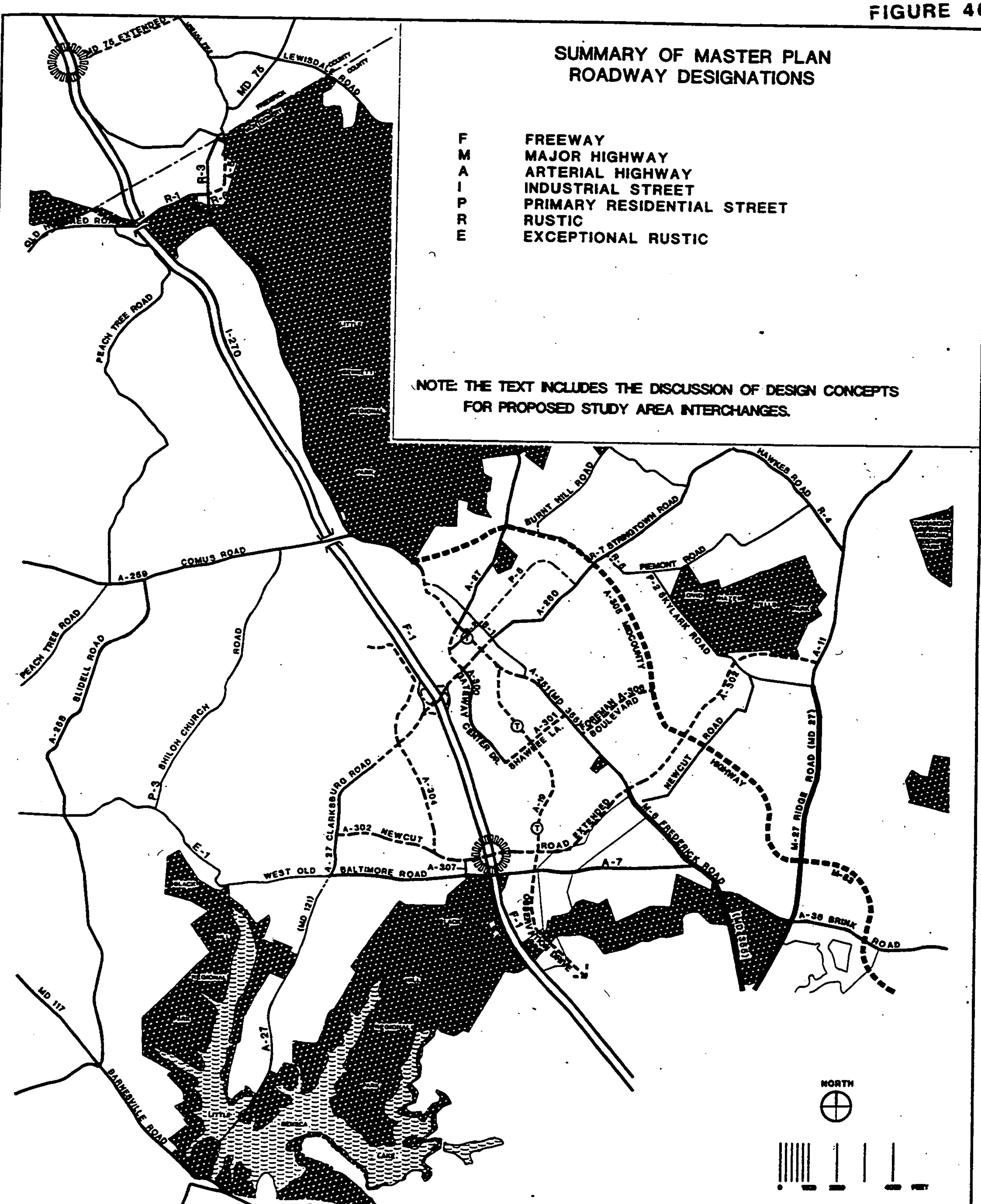
CLARKSBURG MASTER PLAN & HYATTSTOWN SPECIAL STUDY AREA FINAL DRAFT PLAN (1993)

This plan proposes a system of highways, transit routes, and bikeways/pathways to support future development. Major emphasis is placed on transit in accord with plan objectives to make Clarksburg a transit-serviceable community. The transit-related recommendations of the plan include:

- an exclusive transitway, which is part of a larger regional transit network. The transitway could be contained within the entire length of the A-19 (Observation Drive Extended) right-of-way from Germantown to M-83. The transitway joins M-83 and then I-270. North of Comus Road, the transitway's recommended location is within the I-270 right-of-way;
- a regional transitway linking the study area to the City of Frederick to the north and the Shady Grove Metro station to the south;
- high quality regional and local bus routes linking Clarksburg's developed areas to the Boyds MARC station; eventually, longer distance bus connection service from Clarksburg should be provided along I-270 and M-83;
- improved MARC commuter rail service;
- the formation of carpools and provision of park-and-ride facilities transit stations and down-county areas, park-and-ride lots of 50 to 300 spaces should be combined with shopping center parking lots in the neighborhood centers;
- transit-oriented neighborhoods within walking distance of transit stops only.

GENERALIZED HIGHWAY AND TRANSIT PLAN

FIGURE 40

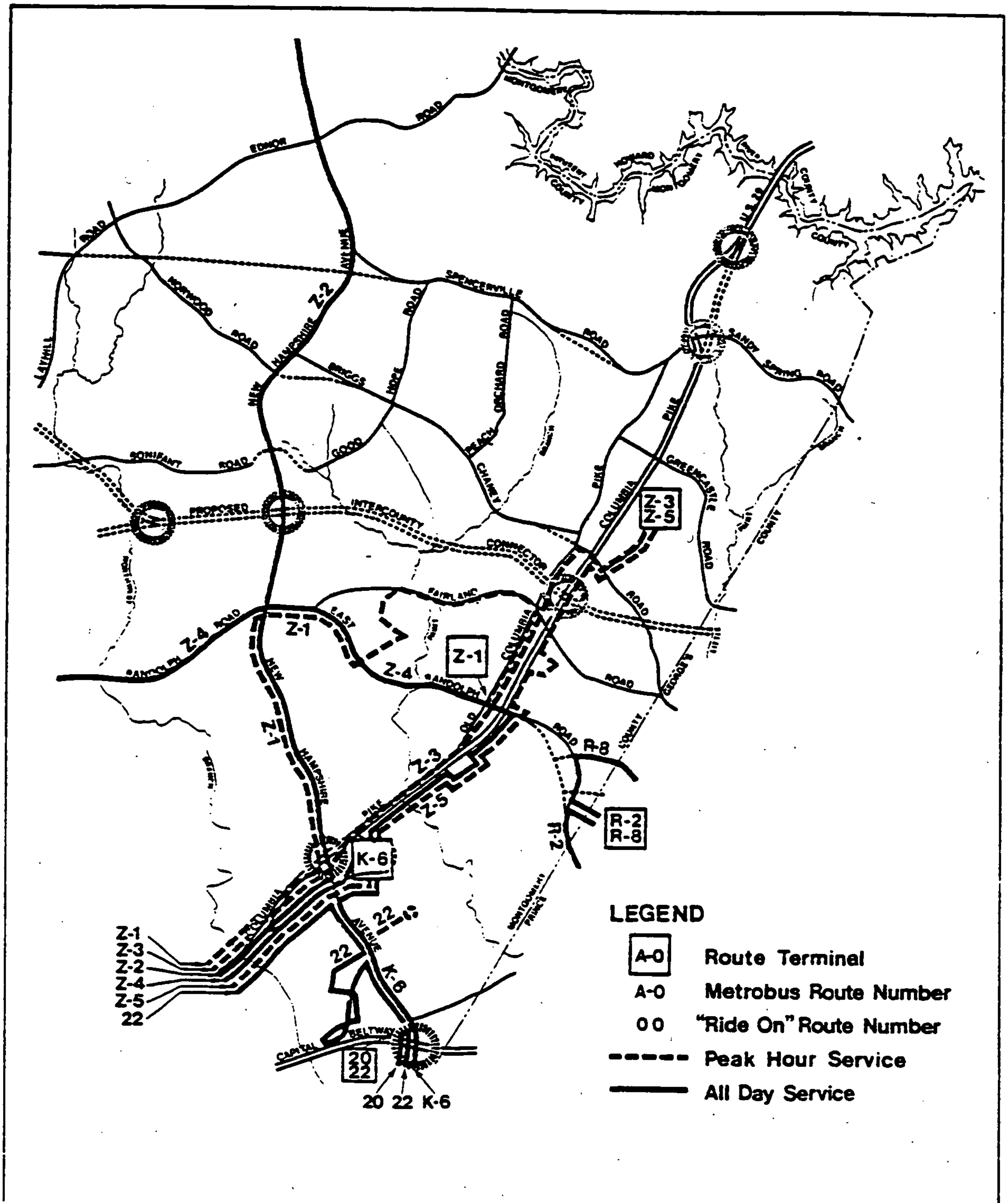


EASTERN MONTGOMERY COUNTY PLANNING AREA MASTER PLAN (1981)

A fundamental aim of the 1981 Eastern Montgomery County Planning Area Master Plan is to reduce automobile dependence. To do so, the master plan recommends a pattern of land use that places major development where alternative travel modes to the automobile can be used. Such alternative modes include public transit, ride-sharing, carpooling, vanpooling, riding bicycles, or walking. The master plan recommends that, with the development of a transit serviceable base, the appropriate level of transit service be provided. Specifically, this master plan recommends:

- locating public fringe (commuter) parking lots where auto occupants can form carpools or transfer to buses;
- operating express bus service linking these fringe parking lots with the Silver Spring and Glenmont Metro stations;
- operating express bus service in the US 29 and New Hampshire Avenue corridors. Fringe parking facilities should be constructed at strategic locations along US 29 to encourage both transit ridership and ridesharing and to help maintain a balance between the projected traffic and the design capacity of the highway network;
- providing dial-a-ride or minibus service connecting communities with the fringe parking lots, shopping and employment centers, and other facilities.

A comprehensive set of amendments to this master plan is scheduled to be completed in 1995. The Issues Report for each of the planning areas in the Eastern Montgomery County Area (Cloverly, Four Corners, White Oak, and Fairland) were released in mid- to late 1993. The ongoing process of revision in Eastern Montgomery County has been closely coordinated with the Transitway and High-Occupancy Vehicle Network Master Plan. The Staff Draft Reports for these efforts are due in mid- to late 1994.



EASTERN MONTGOMERY COUNTY

BUS ROUTES, 1982

NOVEMBER 1981

43

FRIENDSHIP HEIGHTS SECTOR PLAN (1974)

The primary transportation goal of the Sector Plan is to provide an efficient, economical, and safe transportation network which will serve the specific area and the entire metropolitan region. The recommendations to encourage transit ridership in Friendship Heights are as follows:

- provide direct access to the transit station from the highest density activities;
- give preferential treatment for bus movement to and from the transit station;
- develop two types of bus feeder service: operate trunk line service, utilizing standard transit coaches on the major arterial routes only, and use small vehicles (minibus) only for routes on residential streets;
- encourage development of a local-service, fine-grained, small-vehicle transit loop to connect local residential and office buildings with major shopping facilities, in conjunction with the development of a pedestrian network;
- establish a south portal entrance to the Metro station in the District of Columbia.

This area is in an ongoing master planning process. The Issues Report is scheduled to be released in late 1994.

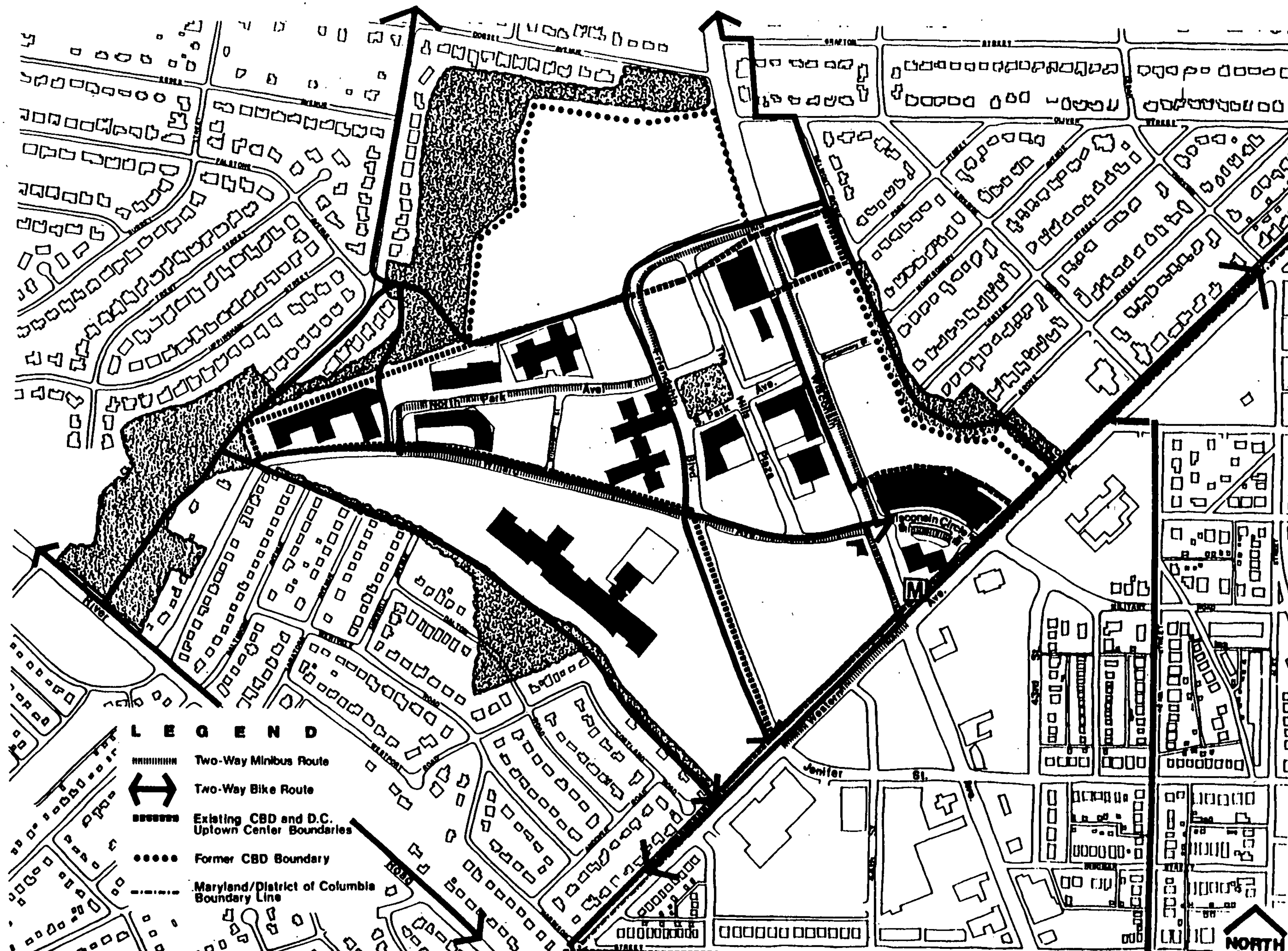


FIGURE 3

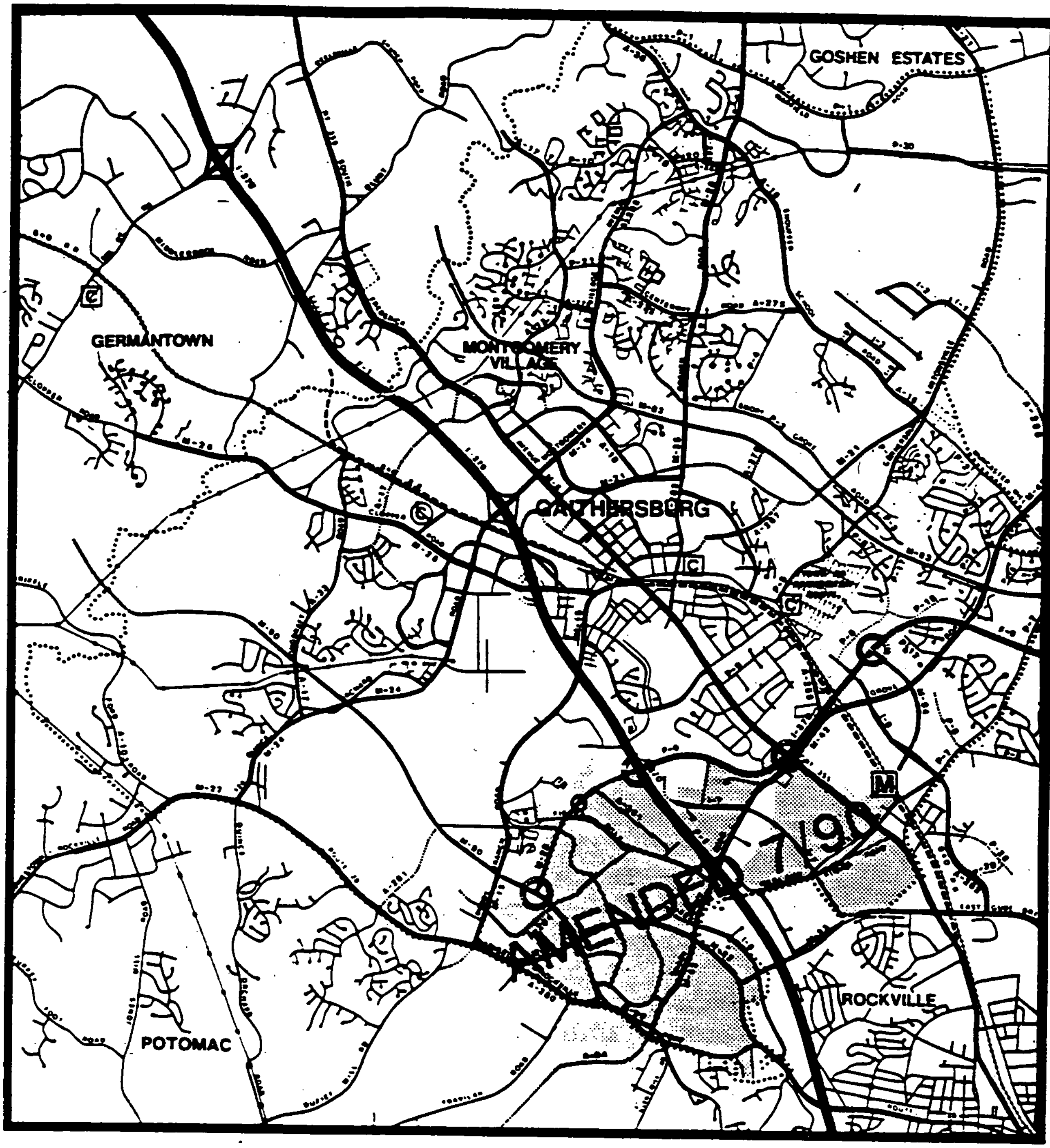
FRIENDSHIP HEIGHTS

BIKE & BUS ROUTES

GAITHERSBURG VICINITY MASTER PLAN (1985)

The intent of this plan is to ensure convenience, accessibility, and flexibility with regard to the area's circulation system in the following manner:

- develop a highway network in coordination with the existing regional network; specifically, the plan supports the construction of I-370 linking the Shady Grove Metro station with I-270, the Intercounty Connector from Great Seneca Highway to the Baltimore-Washington Parkway in Prince George's County, and the extension of Great Seneca Highway from Middlebrook Road in Germantown south to Ritchie Parkway at MD 28;
- develop quality public transportation systems and advance private ridesharing and carpooling programs to reduce dependence upon single-occupancy automobile commuting. Specifically, the Plan recommends that MARC commuter rail service be continued and that an additional station be provided at Metropolitan Grove Road; retain a right-of-way for future bus or rail extension through Gaithersburg to Germantown, and possibly to Clarksburg;
- encourage adequate residential and employment densities to support efficient public transit and carpool/vanpool programs.



TRANSPORTATION PLAN

- Planning Area Boundary
- Transit Easement
- M Metro Station
- C Commuter Rail Station-Existing
- © Commuter Rail Station-Recommended

NOTE: See Text. Actual Alignment May Differ

	Existing	Proposed
Freeway (P-1)		
Major (M-1)		
Arterial/Industrial (A-1) (I-1)		
Primary (P-1)		
Interchange		

APPROVED & ADOPTED GAITHERSBURG VICINITY MASTER PLAN
Montgomery County Maryland
January, 1985

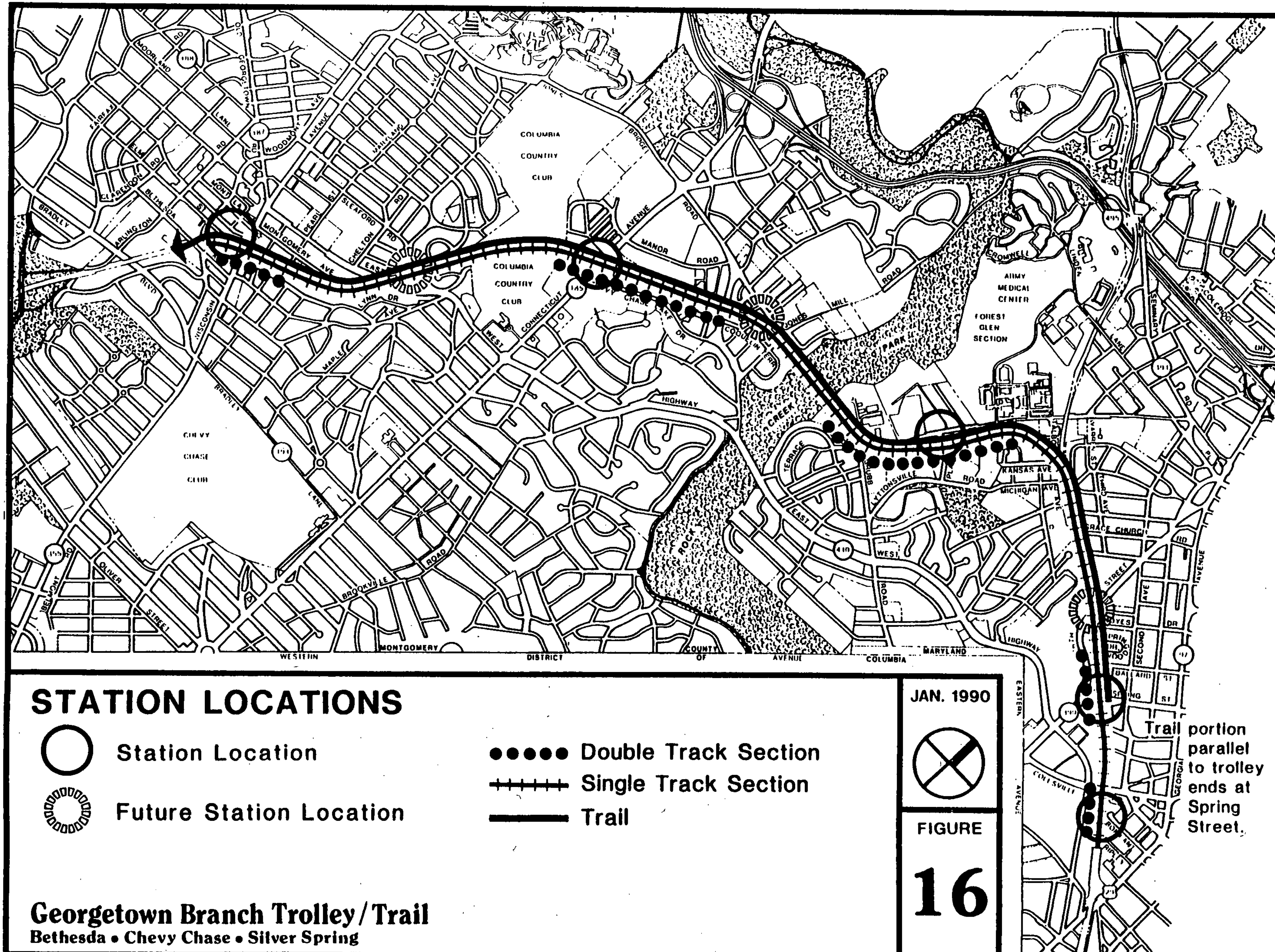
NORTH

Fig. 27

GEORGETOWN BRANCH MASTER PLAN AMENDMENT (1990)

This Plan amends the Georgetown Branch Master Plan Amendment of November 1986 and focuses on the suitability of trolley/trail use for the Georgetown Branch right-of-way. The Plan designates the Silver Spring and Bethesda Trolley and the Capital Crescent Tail as suitable uses for the 4.4-mile portion of the Georgetown Branch right-of-way between Bethesda and Silver Spring. Specifically, the Plan recommends the following:

- the designation of the Georgetown Branch right-of-way as suitable for use as the Silver Spring and Bethesda Trolley and the Capital Crescent Trail between Silver Spring and Bethesda;
- that five trolley stations between Bethesda and Silver Spring be designated. Four of these should be 'express stations' (Bethesda Terminal, Chevy Chase Lake/Connecticut Avenue, Lyttonsville, and Silver Spring Terminal) operating at all times; the other one (Spring Street Station) should be a 'local' station, operating only during non-rush-hour day, evening, and weekend hours. This plan does not deal with the question of specific station design, but recommends that detailed designs be reviewed at appropriate subsequent stages through the Mandatory Referral Process;
- that the southern entrance to the Bethesda Metro Station be connected to the trolley facility to provide a convenient, direct transfer from the Bethesda Terminal station to the Metro station;
- that the Bethesda station design include an extension of the concourse through the platform area in order to provide adequate trail width and safety;
- that an additional 'kiss-and-ride' area be designated on the east side of Connecticut Avenue;
- that the trolley crossing of the Metropolitan Branch be a below-grade tunnel or underpass;
- that any additional right-of-way needed for a future, possible double track configuration along the Metropolitan Branch be identified for future dedication through the subdivision process.



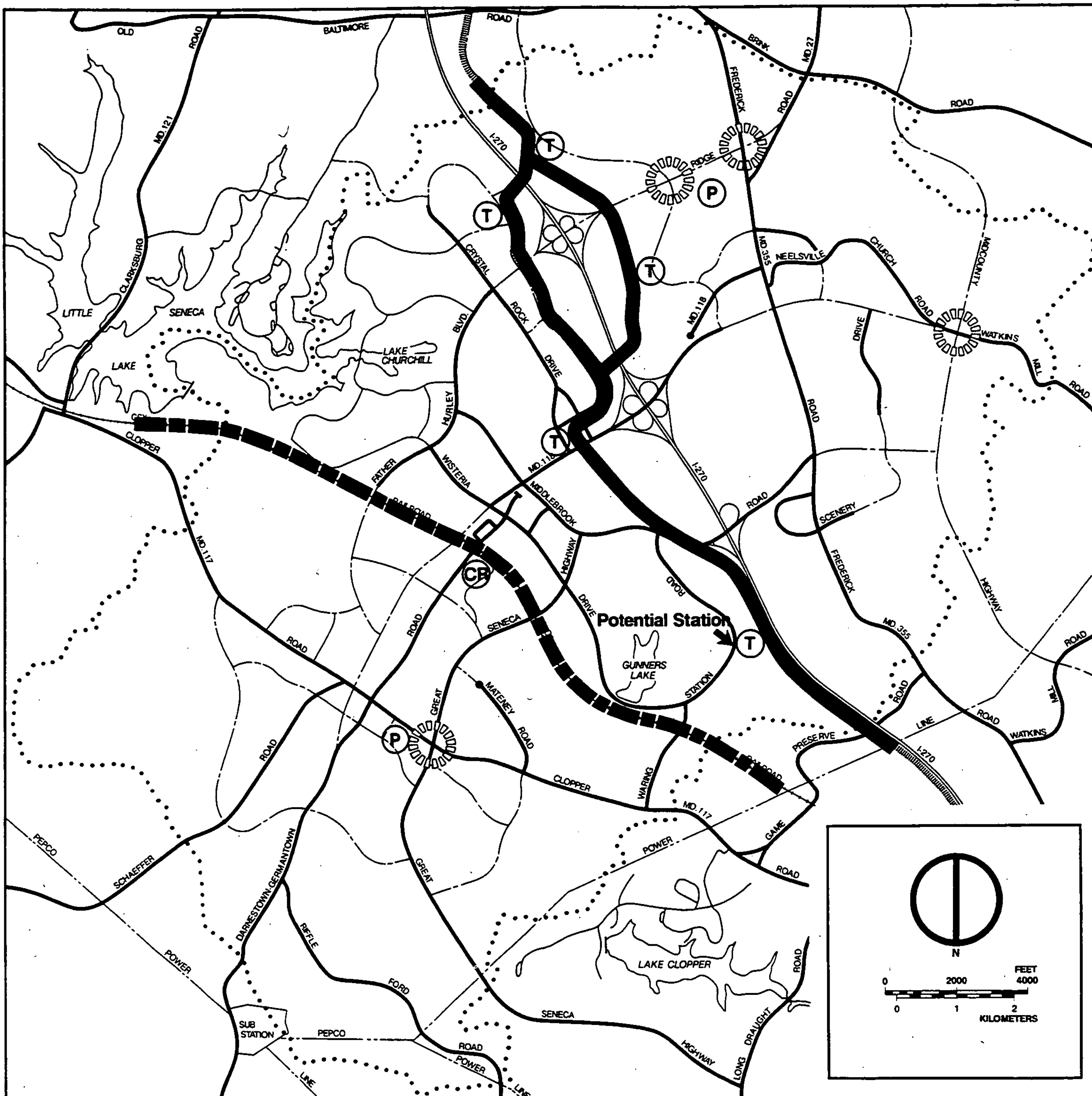
The Maryland - National Capital Park and Planning Commission Montgomery County Planning Board

GERMANTOWN MASTER PLAN (1989)

The intent of this plan is to ensure convenience, accessibility, and flexibility so that Germantown may become a community with transit-serviceable land uses and with a network of highways that provides access to the regional highway system. Specifically, the plan recommends the following:

- develop a high quality transportation system and improved private ride-sharing and carpooling programs to reduce dependence upon single-occupancy automobile commuting;
- support efficient and accessible public transit and carpool/vanpool programs, with particular emphasis on non-peak public transit service to meet needs of employment corridor employees;
- establish two transit alignments for the Germantown Area which would allow transit to serve employment and residential uses on the east and west side of I-270, as well as the Town Center. These transit easement alignments might include at-grade crossings of major highways such as Middlebrook Road (M-85), MD 118 (M-61), and Father Hurley Boulevard (M-27). Five transit stations are recommended, as are parking facilities at each facility;
- expand the parking facilities at the MARC station in Germantown to enhance the use of commuter rail service;
- establish a shuttle bus service to increase accessibility for employees going to and from the transit stations;
- develop park-and-ride lots at a site adjacent to the regional shopping mall site in Neelsville Village and along Clopper Road near its intersection with Great Seneca Highway, adjacent to the Neelsville Village Center.

Figure 37



Existing and Proposed Transit Facilities

Commuter Rail

*Corridor City Transit Easement Alignment

Commuter Rail Station CR

Park-N-Ride Location P

Proposed Transit Stations T

*These and other alternative Alignments are being studied as part of the Corridor Cities Transit Easement Study-See Master Plan and Figure 39.

Comprehensive Amendment to the Master Plan for Germantown

Montgomery County, Maryland

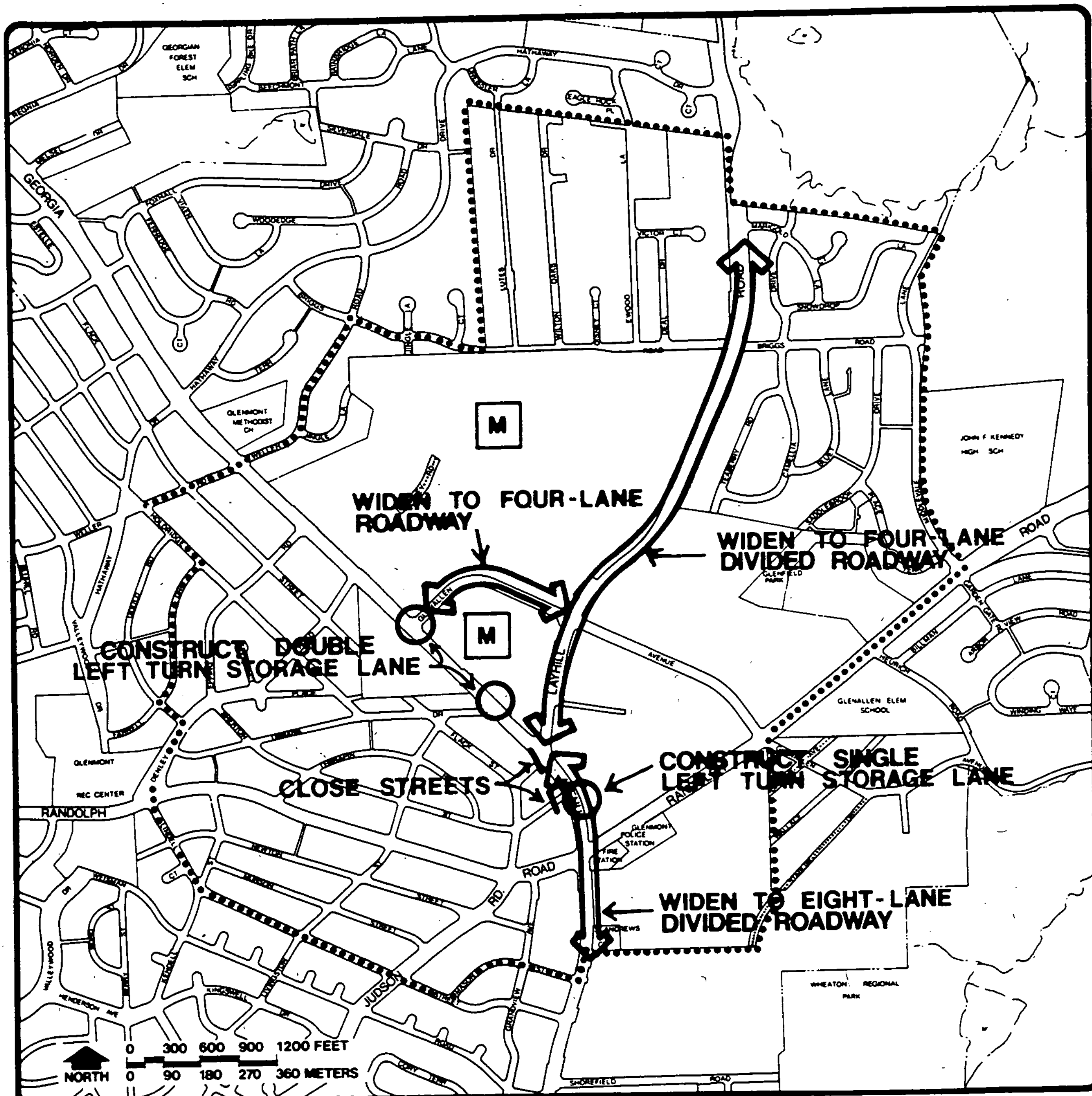
The Maryland-National Capital Park and Planning Commission

GLENMONT TRANSIT IMPACT AREA SECTOR PLAN (1978)

A basic goal of the transportation plan is a balanced and coordinated network of transportation facilities which improve mobility within the community and increase accessibility to and from regional activity centers. The following are specific transportation objectives for achieving this goal:

- integrate the Metro rapid rail facilities into the fabric of the existing community with a minimum of disruption;
- improve transit services to satisfy a wide range of local community needs, including regional, intermediate, and neighborhood bus service;
- improve major roads, where necessary, to assure the continuation of adequate traffic capacity and level of service;
- promote policies to protect neighborhoods from intrusions of commuter parking;
- develop a pedestrian and bicycle circulation network to encourage alternatives to the auto for short local trips.

A planning effort is currently underway for the Glenmont Metro area. The Issues Report was released in June 1994 and the Staff Draft Plan is scheduled for completion in late 1994.



RECOMMENDATIONS - HIGHWAY NETWORK

GLENMONT

JULY 1978

19

SECTOR PLAN KW PLANNING AREA

MNCPPC

KENSINGTON-WHEATON MASTER PLAN (1989)

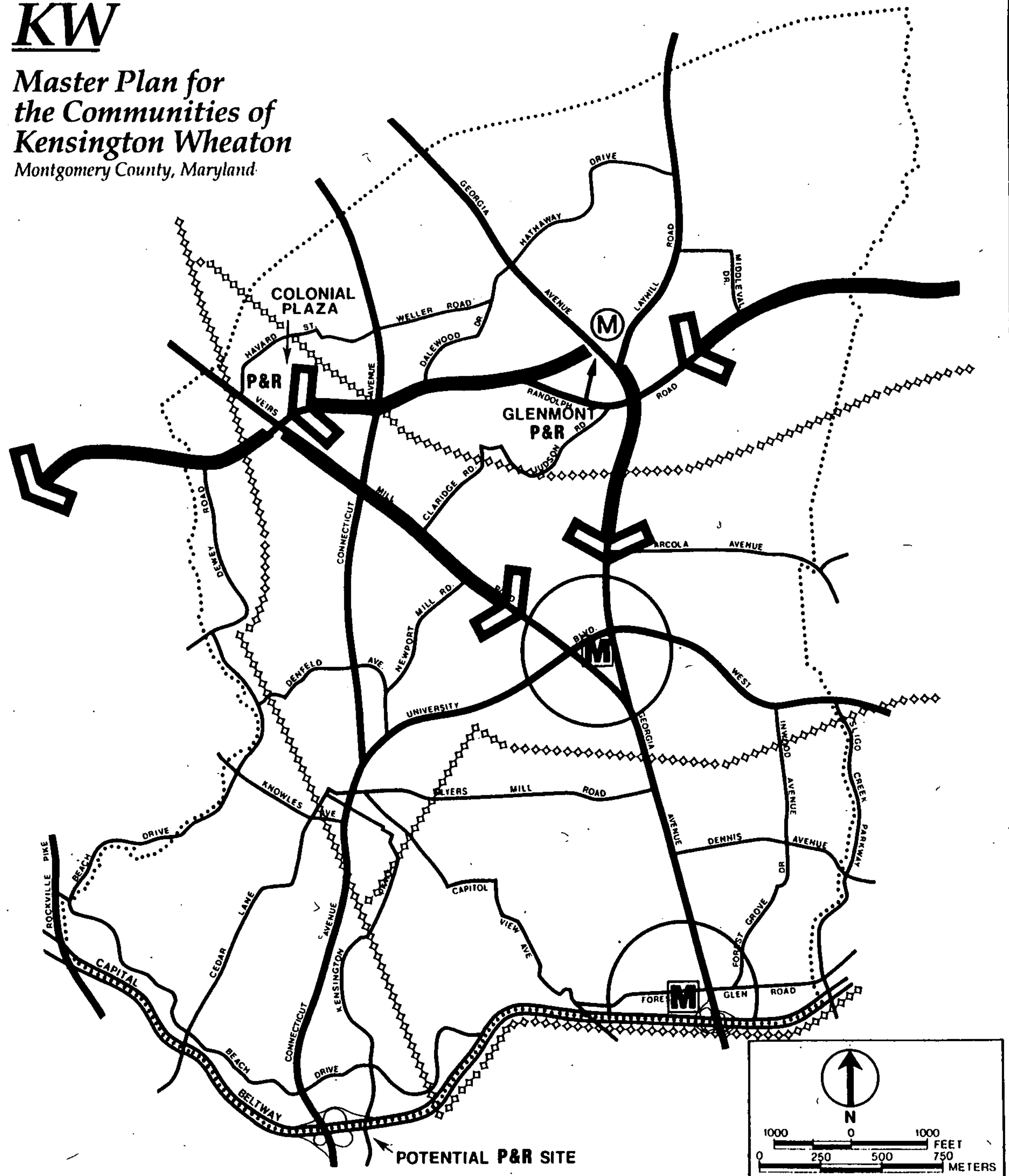
The transportation objective of the Kensington-Wheaton Plan is to establish a transit system in the area that provides a mixture of rapid, intermediate, and feeder transit services that will be an effective alternative to driving. Specifically, this plan recommends:

- completing the Glenmont Metro route to provide a north-south rapid transit route for the Kensington-Wheaton area;
- investigating the potential for east-west rapid transit routes, both within the Kensington-Wheaton area and outside, yet connected to the area such as the Georgetown Branch light rail trolley and the Intercounty Connector;
- encouraging the expansion of service on the MARC line and the development of other improvements that will render commuter rail more reliable;
- providing a feeder bus transit service for Metro stations at Forest Glen, Wheaton, and Glenmont;
- supplementing the bus transit feeder system with the provision of park-and-ride facilities that would be collection points for transit as well as carpools and vanpools.

KW

Master Plan for the Communities of Kensington Wheaton

Montgomery County, Maryland



Park and Ride Lots

- PLANNING AREA BOUNDARY
- PARK & RIDE SHUTTLE ROUTE
- METRO SERVICE AREA
- P&R PARK & RIDE LOT
- M METRORAIL STATION
- METRO AND PARK & RIDE PRIMARY IMPACT AREA (2000 FOOT RADIUS)
- (M) PLANNED METRORAIL STATION

Illustration 5-6

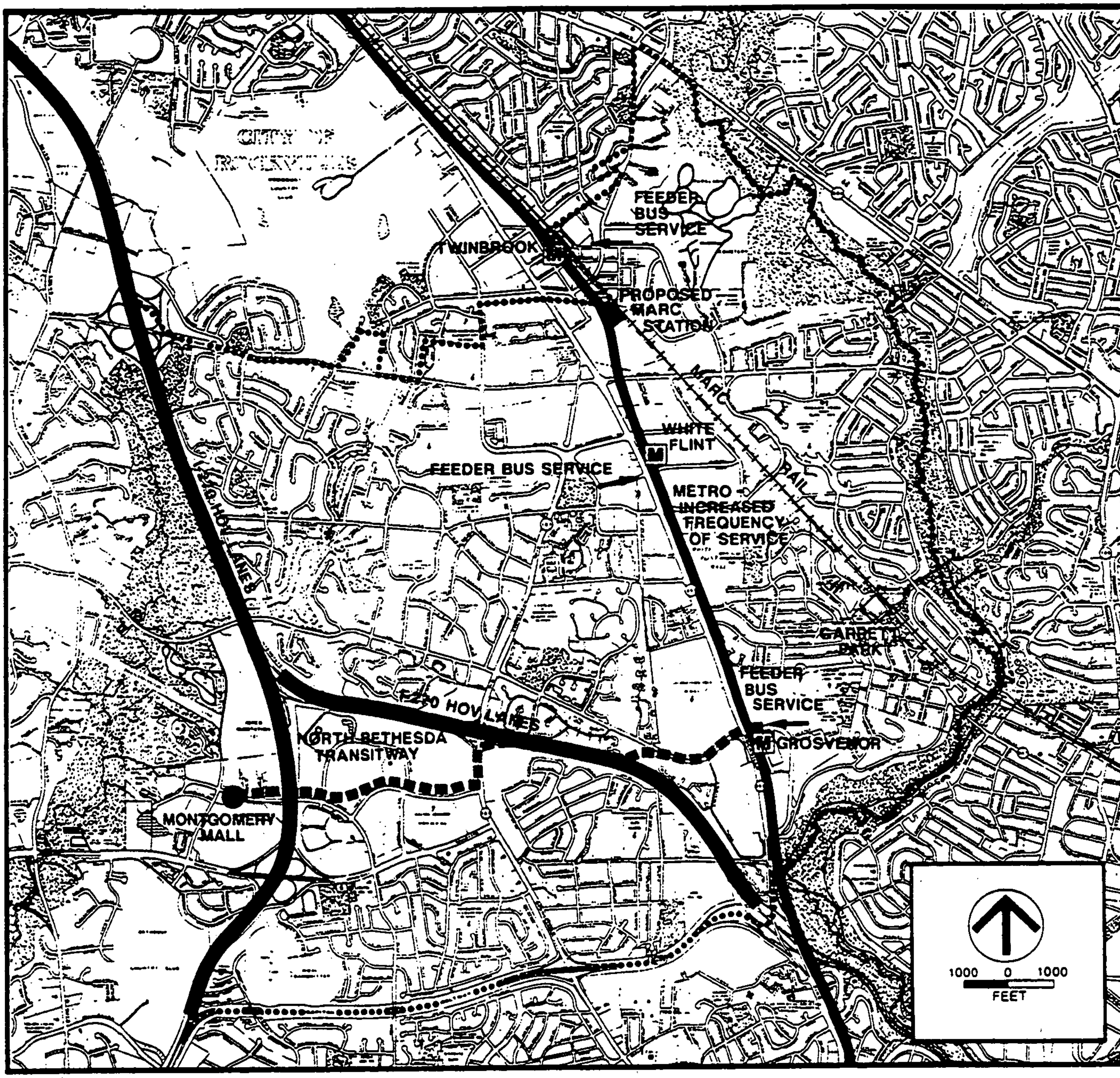
The Maryland-National Capital Park & Planning Commission

NORTH BETHESDA-GARRETT PARK MASTER PLAN (1992)

This plan recommends additional roadway capacity, together with new transit services and demand management programs, to provide a balanced transportation system to serve the recommended land use plan. Specifically, the plan makes the following recommendations:

- encourage transit-accessible land use patterns around Metro stations;
- implement HOV lanes on I-270;
- provide a high capacity transit connection between the Grosvenor Metrorail station and Montgomery Mall via Rock Spring Park.
- expand the roadway network to provide improved circulation and access to existing, approved, and future development;
- create a transportation management district around Metro and Rock Spring Park. This management district could implement traffic mitigation programs, increase or institute parking charges, or decrease parking supply; hold fare increases to the minimum;
- construct the Montrose Parkway from Montrose Road to Veirs Mill Road and retain the remainder of the Rockville Facility right-of-way for a possible future transitway;
- run every northbound Metro train all the way to Shady Grove;
- provide increased local bus services as feeders to the Metro stations and connect the stations with employment locations;
- provide a MARC station in the northeast corner of the Montrose Crossing site near the intersection of Chapman and Bou Avenues.

Figure 53



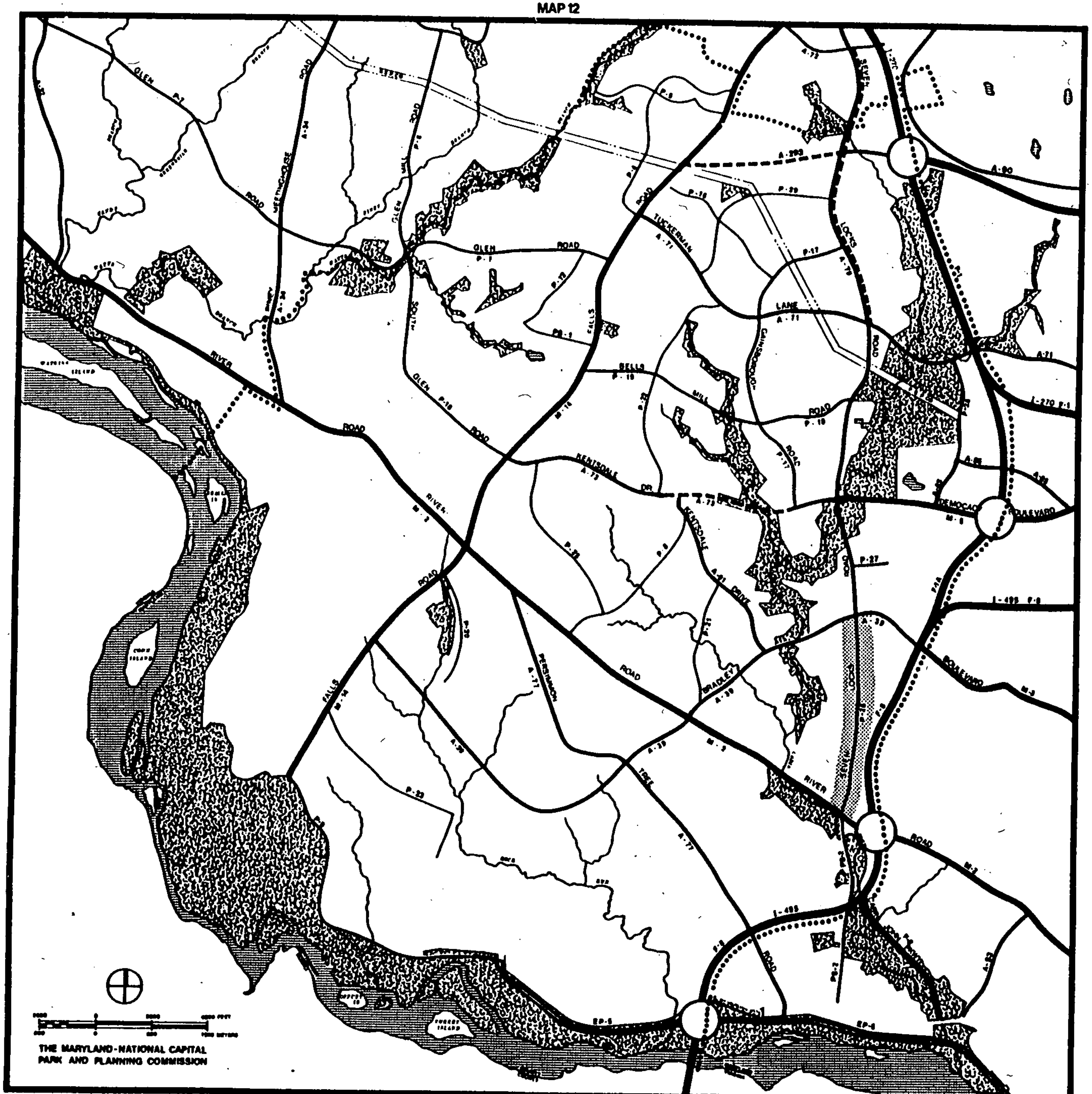
PROPOSED PUBLIC TRANSPORTATION SYSTEM IMPROVEMENTS

North Bethesda-Garrett Park
Planning Area

POTOMAC SUBREGION MASTER PLAN (1989)

The Potomac Subregion Master Plan recommends a limited number of roadway improvements and changes to the transit system only when the Rockville Metro station opens. The goal of the transportation section of the plan is to retain the semi-rural character of the subregion through a limited number of roadway improvements, even though congestion will occur. The plan does recommend that new and expanded bus service to serve Potomac residents traveling to the Rockville Metro station when it opens.

MAP 12



Master Plan
FOR THE
Potomac Subregion

POTOMAC–CABIN JOHN AND VICINITY P.A. 29

RECOMMENDED HIGHWAY IMPROVEMENT

Freeway

Major Street

Arterial Street

Primary Street

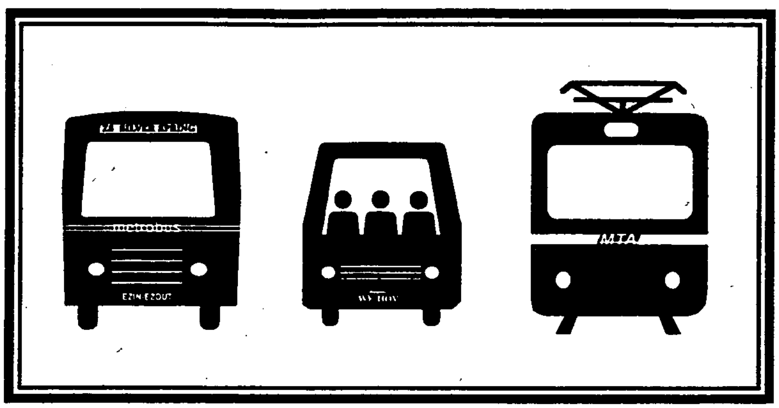
Proposed 2-Lane Roadway

Proposed 4-Lane Roadway

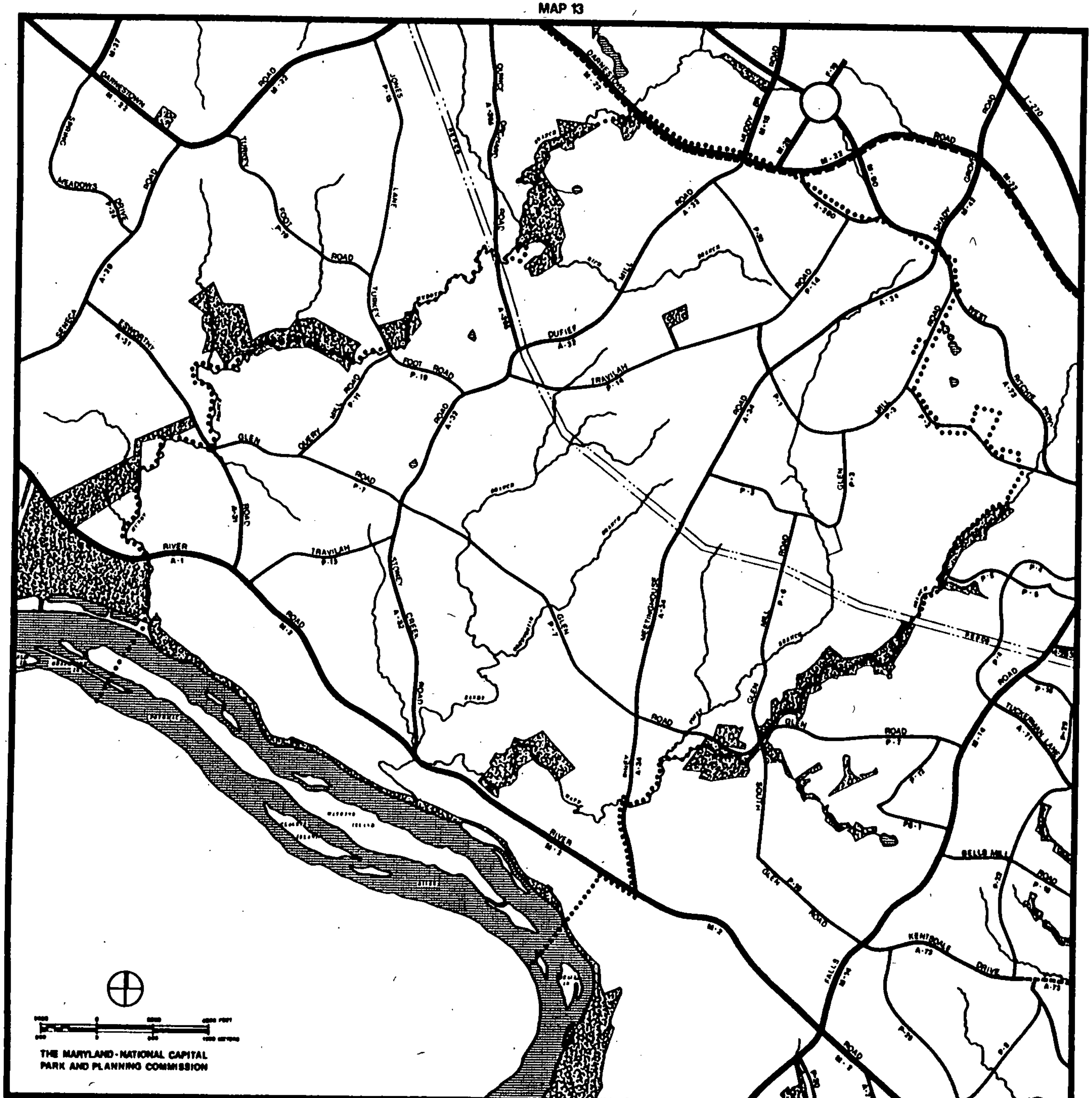
Proposed Widening 4-Lane Roadway

Planning Area Boundary

Shaded area has been amended. See Amendment 3 in the Appendix.


metrobus
MTA

MAP 13



Master Plan
FOR THE
Potomac Subregion

TRAVILAH AND VICINITY P.A. 25

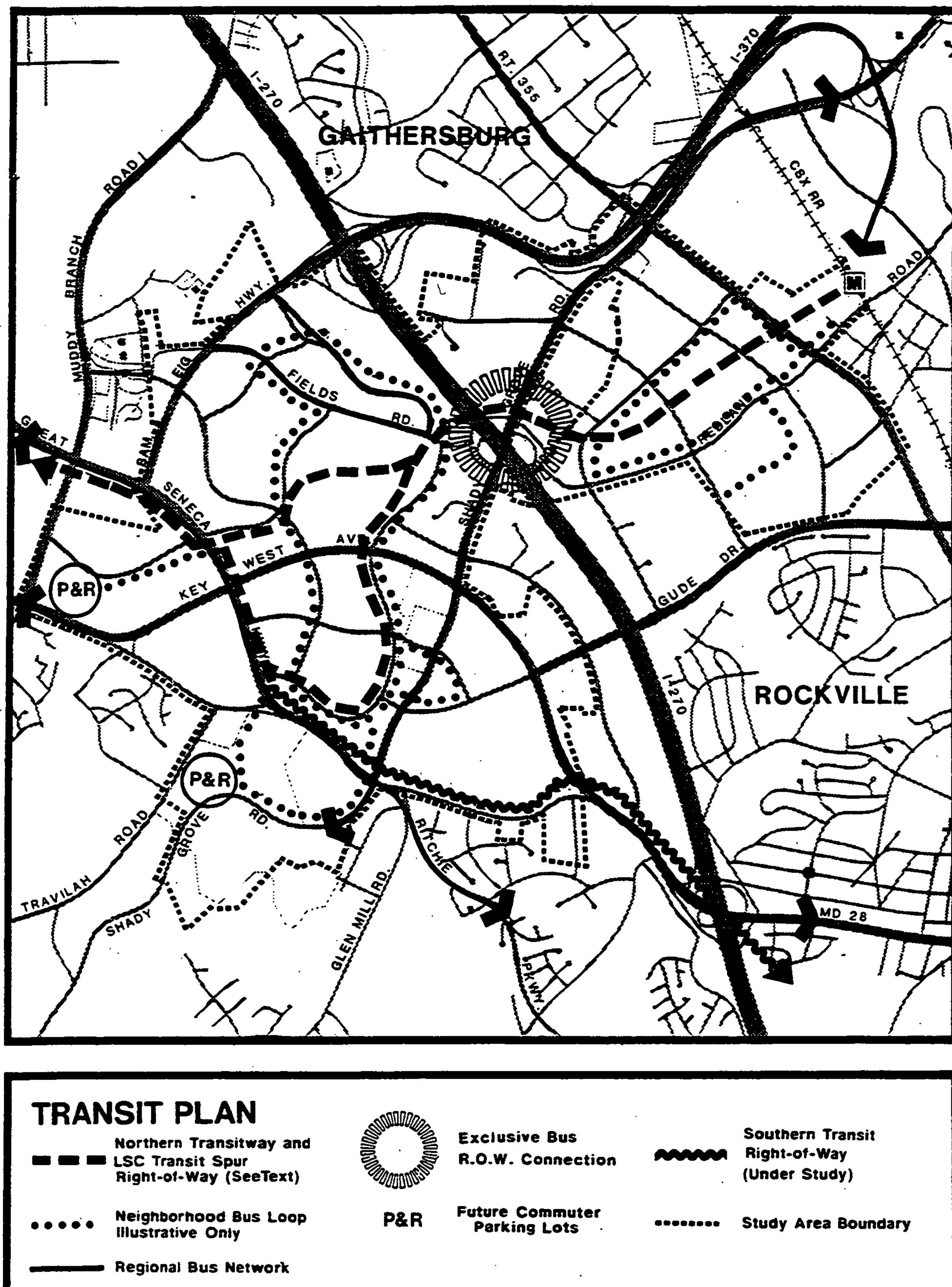
RECOMMENDED HIGHWAY IMPROVEMENT

- Freeway
- Major Street
- Arterial Street
- Primary Street
- Proposed 2-Lane Roadway
- Proposed 4-Lane Roadway
- Proposed Widening 4-Lane Roadway
- Planning Area Boundary

SHADY GROVE STUDY AREA AMENDMENT (1990)

The Shady Grove Study Area amends the Gaithersburg Vicinity Master Plan. Its transportation plan includes a system of highways, access roadways, transit routes, and bikeways/pathways to form an integrated network of access throughout the area. Major emphasis is placed on exclusive transit rights-of-way through the area. Specifically, the transportation portion of the plan recommends the following:

- construct the Corridor Cities Transitway along the alignment, bringing it into the Crown and Washingtonian sites and north along Great Seneca Highway and Quince Orchard Road;
- study a southern transitway alignment providing access to the area west of I-270 from North Bethesda and Rockville;
- provide a transitway spur along Omega Drive and Medical Center Drive from the Corridor Cities Transitway that would serve the Life Sciences Center;
- encourage development of a public/private partnership for implementation of the exclusive transitway facilities serving the planning area;
- encourage the founding and operation of a transit management organization in the study area to assist in monitoring and managing traffic conditions;
- encourage adequate residential and employment densities to support efficient public transit and carpool/vanpool programs;
- encourage the development of public and private pathways for pedestrian movement in concert with road design and construction.



APPROVED AND ADOPTED

SHADY GROVE STUDY AREA PLAN

MONTGOMERY COUNTY, MARYLAND JULY 1990

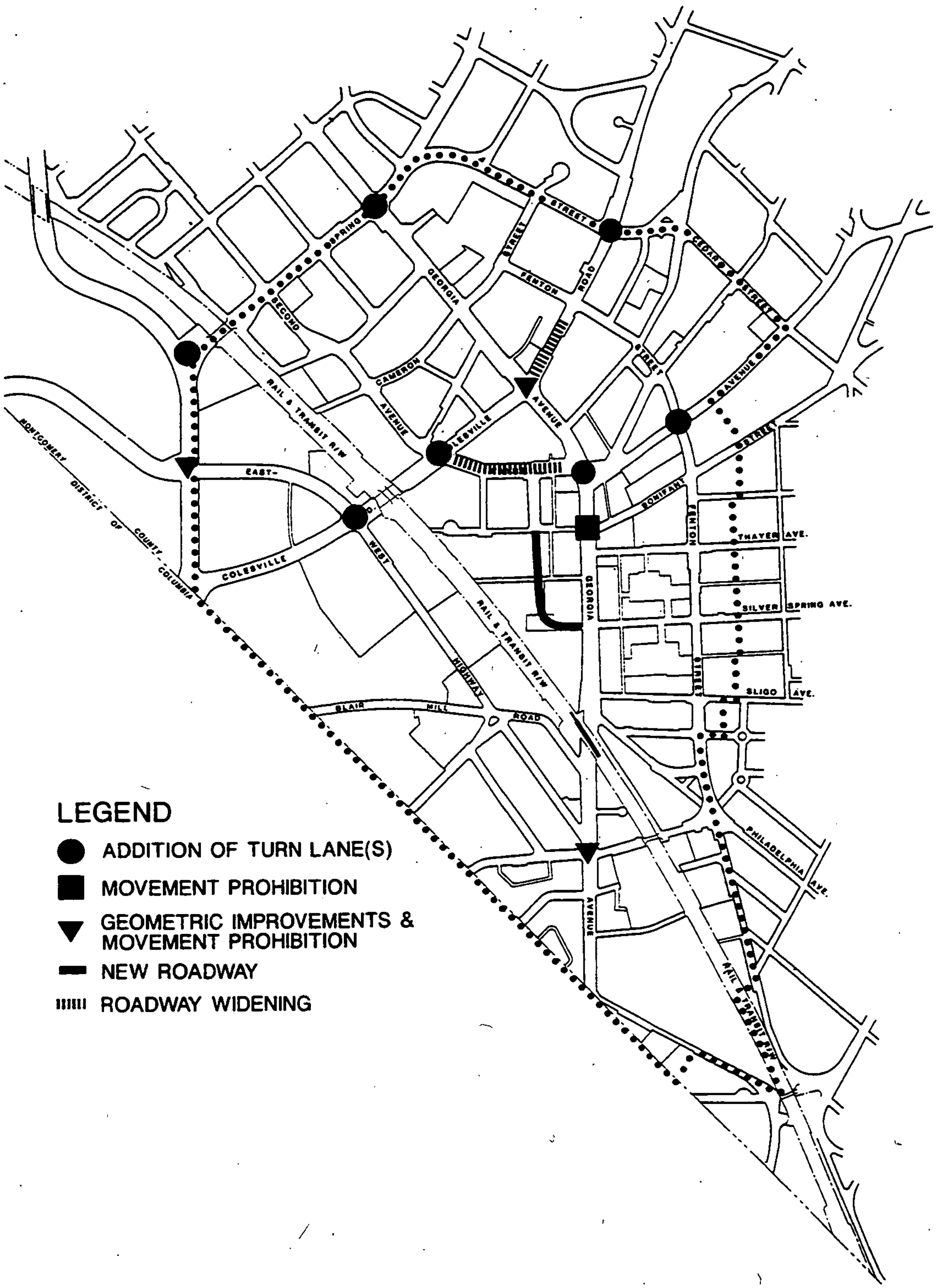
NORTH

Fig. 7.1

SILVER SPRING CBD SECTOR PLAN (1993)

The basic transportation objectives of the sector plan are to provide a safe environment for motorists and pedestrians and adequate access to commercial development and community services. This plan supports (1) the extension of the Metro Red Line to Glenmont, (2) the expansion of bus service on US 29, and (3) increased service on MARC commuter rail. Specific recommendations include:

- support Transportation Management District (TMD) objectives to attain any combination of mode choices that result in an average of 54 percent of the workers driving to destinations in the CBD during the peak period. The future goal of the TMD is to reduce this share to 50 percent;
- pursue the consolidation of the transit terminal area including the relocation of the Silver Spring MARC station closer to the Silver Spring Metro station between Bonifant Street and Colesville Road to form a transportation hub;
- support the development of the Georgetown Branch trolley connecting the Silver Spring transportation hub with the Bethesda Metro station. Another station may be located in Silver Spring at Spring Street for service during non-peak hours;
- consider reorganizing existing bus service so that all buses board and unload at common points;
- consider increasing the frequencies of buses along certain designated routes;
- consider operating special buses to connect Metro with retail centers and other locations in the CBD;
- consider creating a special fare zone to allow employees or customers to receive passes, tokens, or tickets that will allow them to board any bus operating within the CBD free of charge.



North

400 0 400
200 800 feet

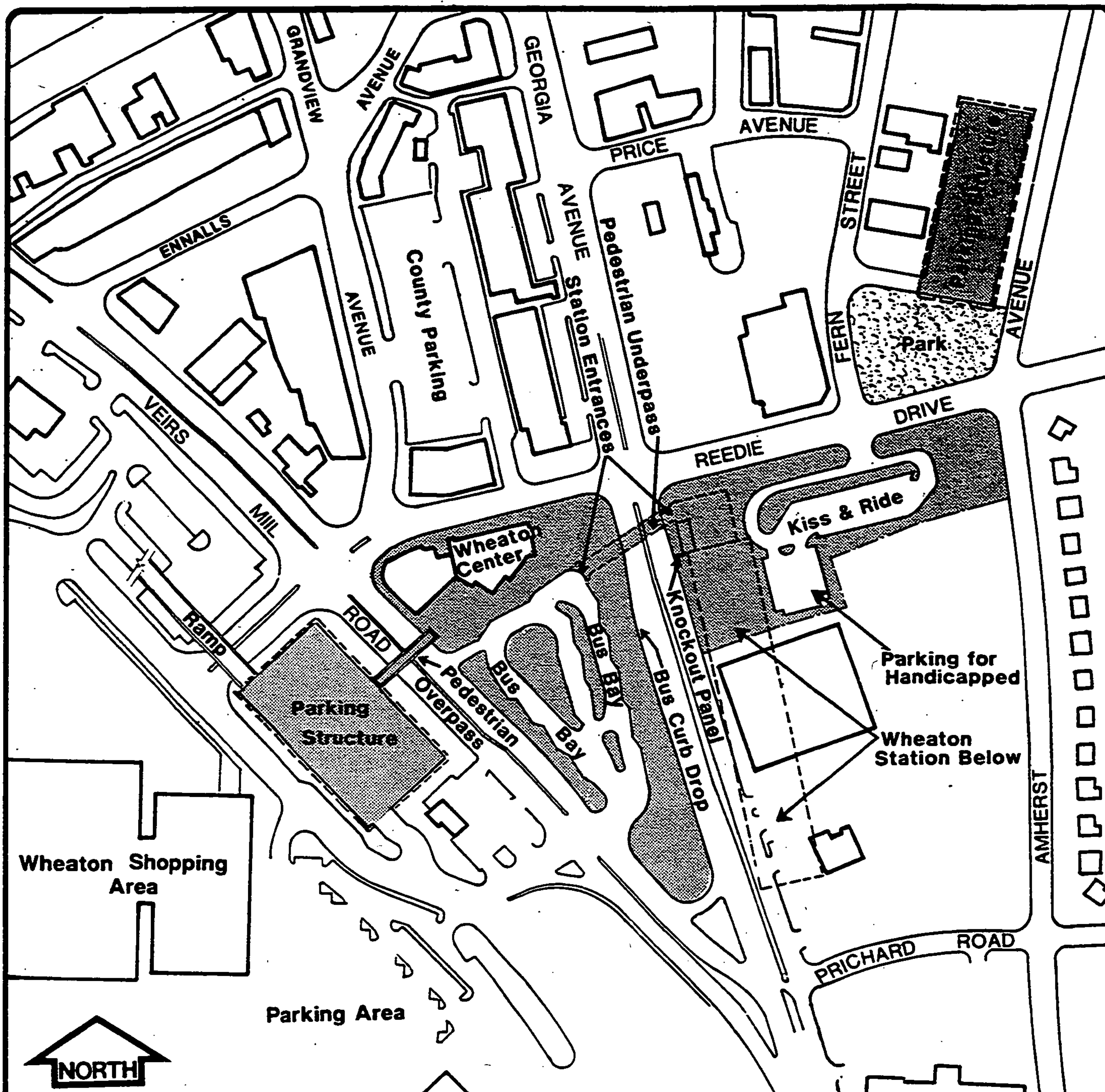
Recommended Internal and Portal Roadway Improvements

Figure 5.15

WHEATON CBD SECTOR PLAN (1990)

The transportation objective of this sector plan is to provide a balance and coordinated network of transportation facilities that provides safe and efficient mobility within the community as well as increased accessibility to activity centers.

- to accommodate demand for parking, a facility at the future Glenmont Metro station should be constructed before it is built. An associated improvement should be increased bus service between Glenmont and Wheaton so those who park at the former can board Metro at the latter;
- a kiss-and-ride lot should be built between Georgia Avenue and Amherst Avenue that will have over 75 spaces, including a substantial amount of handicapped parking and sufficient waiting area for taxis. Also, 14 bus bays will be constructed in the area bounded by Georgia Avenue, Veirs Mill Road, and Reedie Drive;
- a Transportation Management Association (TMA) is recommended for the CBD area. The TMA is a voluntary agreement between businesses and local government that provides incentives to encourage commuting to work by modes other than the single-occupant vehicle.



METRO STATION PLAN

WHEATON

MNCPPC

SEPT. 1990

10

SECTOR PLAN
KW
PLANNING AREA


metrobus
MTA

APPENDIX L

PLANNING

BACKGROUND

SUMMARIES


metrobus
MTA

Appendix L Planning Background Summaries

This appendix reviews relevant county-wide planning documents, emphasizing their transportation recommendations.

...On Wedges and Corridors; a General Plan (1964)

Updated General Plan (1969)

General Plan Assessment Study (1987)

Envisioning Our Future (1988)

Comprehensive Growth Policy Study (1989)

I-270 Corridor Cities Transit Easement Study (1990)

Action Agenda: Growth Management Advisory Work Group (1991)

Transportation Network Studies - Phase I (1992)

General Plan Refinement of the Goals and Objectives
for Montgomery County (1993)

...On Wedges and Corridors: a General Plan

January 1964

The original 1957 General Plan covered a Maryland-Washington Regional District that only included the developed areas of Montgomery and Prince George's Counties. In 1959, the Regional District was expanded to its present boundaries: all of both counties except for some independent municipalities and the rural southern part of Prince George's County. "On Wedges and Corridors" was prompted by this expansion of the planning area and by the newly created metropolitan-area-wide framework of planning established by "A Policies Plan for the Year 2000," 1961, which advocated a radial corridor pattern for the metropolitan area, and the "Mass Transportation Survey Report," 1959, which showed the superiority of mass transit over private cars. By 1962, a staff draft of "On Wedges and Corridors" was printed and in 1964 a revised version was approved and adopted.

The general philosophy of the plan is to concentrate growth in transit corridors in an urban ring around Washington, D.C. This was an appropriate pattern in a time when the suburbs were bedroom communities and the government's intent was to concentrate federal construction in a largely-rebuilt downtown Washington.

Key features of the plan:

- rapid transit
- efficient land use
- new towns and residential clusters with varied living environments
- greenbelts and open space preservation

It is very much an anti-sprawl plan, envisioning high-rise corridor city centers, residential lot sizes similar to the then-current 6,000-9,000 square feet, and no large-lot subdivisions in the wedges. The only people expected to live in the rural areas (wedges) were those dependent on the rural areas for their livelihood. Major rural area uses: natural resource businesses such as farms and mines, outdoor recreation such as summer camps and golf courses, conservation uses such as wetlands and wildlife refuges, and institutional uses such as nursing homes and cemeteries.

Despite the emphasis on rapid transit to serve the corridors, the plan's transportation element has several major highways not built today. Major unbuilt east-west highways include an outer beltway and a major highway from Rockville to Laurel roughly following MD 28 and MD 198.

Another feature of the plan is its emphasis on the necessity of regional and interagency cooperation and planning.

Updated General Plan

December 1969

All policy statements found anywhere in the General Plan and in any of the adopted area master plans were extracted and grouped under five headings, referred to as the "elements" of the General Plan. Under such headings the policy statements were classified as general goals to be accomplished, objectives leading to their accomplishment, or guidelines indicating specific courses of action. Those policy statements were then revised. According to the plan update, the most significant change since the General Plan preparation was faster-than-anticipated population and employment growth. The update also reflected changes in theory and practice that emphasized dynamic planning over static plans, the planning process over planning maps, and policy statements over geographical predetermination. New planning requirements incorporated into the update included development staging and citizen participation.

Land Use

Goal - Achieve a balance among the various land uses insofar as the proper amount, types, and distribution of each results in an environment and diversity of lifestyles that fulfills the requirements of county residents.

Circulation

Goal - Provide a balanced circulation system which most efficiently serves the economic, social, and environmental structure of the area.

Conservation

Goal - Conserve valuable natural and historic areas for the benefit of present and future generations.

Environmental

Goal - Provide an aesthetic and healthful environment for present and future generations.

Housing

Goal - Stress the present quality and prestigious image of residential development in Montgomery County by further providing for a full range of housing choices, conveniently located in a suitable living environment, for all incomes, ages, and lifestyles.

General Plan Assessment Study

January 1987

This study assesses how well Montgomery County will function if it continues to develop or "build out" in accordance with the General Plan, as amended by master plans. The study starts by reviewing the basic concepts behind the General Plan and assessing their current validity. The study then looks at the current relationships between major tools that implement the concepts in the General Plan. The relationships are assessed in terms of three basic questions.

1. Will the County's current zoning result in more work trips than can be accommodated by the transportation network envisioned by the Master Plan of Highways?
2. Will the build-out of the current zoning result in more sewage and solid waste than can be accommodated by existing and planned treatment capacity?
3. Will the fiscal, economic, and social implications of the current zoning pattern satisfy the needs of the future?

The study's conclusions:

"The General Plan's basic concept appears sound, since it still appears to provide a better solution to increasingly critical transportation and environmental issues than a more sprawling development pattern would provide."

"While the basic concepts of the General Plan appear to be sound, the zoning and transportation infrastructure patterns that implement it may need adjustment to insure adequate long-term transportation capacity." When the total amount of growth allowed by current zoning was compared with full development of presently planned transportation facilities, the resulting traffic congestion was intolerable. A second test using reduced commercial development and adding transit services resulted in traffic congestion that was still heavy, but tolerable.

"While the basic concepts of the General Plan appear to be sound, the zoning and general public services infrastructure may need adjustment to insure adequate long-term fiscal, economic, and social balance." Current zoning, if built out, will result in a jobs/housing (J/H) ratio much higher than today's, although research suggests that the J/H ratio for suburban counties appears to be self-limiting to below 2.0. A significantly higher J/H ratio than the current 1.6 would have serious implications for housing supply and costs, tax revenue, transportation, and other social and economic factors.

"A Comprehensive Growth Policy Study should be undertaken to provide a reference framework for insuring that both long-range master plans and the Annual Growth Policy remain consistent with the basic concepts of the General Plan."

Envisioning Our Future

June 1988

The Report of the Commission on the Future of Montgomery County, Maryland

Purpose: To identify key trends and highlight critical and emerging challenges likely to shape the County's future and make recommendations.

Four major themes emerged: 1) foster a greater sense of community, 2) manage growth at a moderate level, 3) demographic changes have a profound implication for the County's future, and 4) our children need a strong preparation to meet the future.

Planning for Orderly Growth

- Reassess the General Plan, replanning the two corridors and maintaining the Agricultural Reserve;
- Encourage steady growth of selected new jobs at about half the recent rate;
- Increase housing production by 50 percent;
- Restrict low-density employment and require convenience commercial uses in all major employment centers;
- Develop a comprehensive, functional transportation plan with neighborhood jitneys and a free bus service.

Neighborhoods

- Explore locally elected neighborhood councils;
- Permit home occupations and small businesses;
- Encourage the creation of magnet centers that can be operated and used by neighborhoods;
- Appoint an ombudsman for neighborhood issues;
- Encourage County government to work with neighborhoods on public transportation issues;
- Ensure that it is possible to travel by foot or bicycle within neighborhoods.

Housing

- Strengthen implementation of the County's housing policy so that anyone has the opportunity to live anywhere in the County;
- Provide incentives to encourage the construction of housing near Metro stops;
- Increase low- and moderate-income housing;
- Build more urban-like neighborhoods with closely knit housing balanced with amenities.

Envisioning Our Future

(continued)

Environment and Health

- Require gasoline stations to install gas vapor recovery devices at the pump and adopt more stringent emissions standards for all vehicles;
- Expand the role of County government as a protector of the health of its citizens.

Government and Finance

- Explore various options for increased sources of revenue;
- Maintain good management practices;
- Expand cooperative links with neighboring jurisdictions;
- Plan, in a systematic and orderly way, for the future.

Comprehensive Growth Policy Study (CGPS)

August 1989

The four volumes of the CGPS contain a technical analysis of current trends and forces that affect current growth. They also suggest some possible directions for a policy response. Volume 1, *A Policy Vision*, summarizes the major conclusions of the study. Volume 2, *Alternative Scenarios*, details how alternative future growth scenarios were evaluated. Volume 3, *Global Factors*, summarizes the views of a number of experts with regard to trends and forces at work in the world that could affect the County. Volume 4, *Appendices*, contains a variety of supporting information that is referenced in the other volumes.

The CGPS addresses four basic questions:

1. **Can we grow without excessive congestion?**

Yes, but only under certain conditions. Basically, the number of cars on the roads must be managed. Achieving a goal of reducing the average auto driver share of work trips from 75 to 50 percent would do much toward this end.

To accomplish such a goal, we would need to:

- introduce new travel networks, such as light rail, van, and hiker/biker trails,
- cluster land uses at points along these networks, such as in urban village centers, and
- take actions to help people break the car habit, such as through auto/transit pricing and pedestrian friendly design.

2. **Can we afford the cost of growth?**

Probably, but only under certain conditions. Primarily, some funding patterns need to shift from the private sector to the public sector. Some ways to help this could happen:

- further tax the use of the private auto, such as through a gas tax, increased parking fees, etc., and
- obtain more direct state and federal road and rail construction.

3. **How should we approach these problems?**

The growth management problem is nationwide, even worldwide. Primarily, the challenge is how to control urban sprawl and contain the environmental, economic, and social costs it engenders. While Montgomery County has accomplished more in this regard than most of the suburban jurisdictions in the nation, an additional challenge faces us in terms of travel behavior. The County's Commission on the Future has pointed the way. Without losing sight of "Wedges and Corridors," we should consider shifting our focus toward a vision called "Centers and Trails."

Comprehensive Growth Policy Study

(continued)

4. **Are the present management tools adequate?**

No, refinements should be considered. For the long run, the most important would appear to be the establishment of appropriate state and local growth management agreements and mechanisms. But also, within Montgomery County, the following could be candidates for further exploration and action over the next several years:

- a new Travel Network Plan to preserve rights-of-way for light rail, van, and hiker/biker trails,
- establishment of adequate local revenue sources, such as a local piggyback on the state gas tax,
- revision of master plans and zoning over time to further reduce sprawl and increase strategic concentration,
- incorporation of transit/pedestrian-friendly design principles into the subdivision and site plan review process,
- resolution of legal issues regarding how to enforce staging limits that are defensible at court (APFO test at subdivision vs. at Zoning), and
- expansion of research into the economic and fiscal forces that affect housing prices, and policies to address the affordability issue.

I-270 Corridor Cities Transit Easement Study

March 1990

The Montgomery County Master Plan of Highways and related master plans identify a transit easement for public use from the Shady Grove Metro station north through Gaithersburg and Germantown to Clarksburg. The Corridor Cities Transit Easement Study is part of a comprehensive effort to reevaluate the location of this easement.

Three alternative transit alignments of an initial eight alignments became the focus of evaluation. They were found to offer the greatest potential benefits, from a variety of perspectives including development costs and land use planning opportunities. The three potential easements are:

1. **Alternative 1** - This alignment uses the CSX right-of-way between Shady Grove and Metropolitan Grove and the west side of I-270 to reach Germantown. It then crosses over I-270 north of the proposed Germantown Town Center and continues to Clarksburg in new right-of-way between I-270 and MD 355. The alignment's terminus is about one mile north of MD 121 (Clarksburg Road) between MD 355 and I-270.

2. **Alternative 3** - This potential busway easement was originally proposed to use I-370 and expanded rights-of-way of I-270 for most of its alignment between Shady Grove and Clarksburg. A preliminary engineering assessment of the feasibility of expanding the I-270 right-of-way just north of the I-370 interchange conducted during Phase III of the I-270 Corridor Cities Transit Easement Study concluded, however, that locating an exclusive busway in the area was possibly impractical and too costly. The busway alignment between the Shady Grove Metro station and Metropolitan Grove has, as a result, been subsequently modified in its southern segments to follow the alignment of Alternative 1 from Shady Grove to Metropolitan Grove, or as a second option, the Alternative 8 alignment through west Gaithersburg.

   Between Metropolitan Grove and Germantown, the busway is proposed to follow the I-270 along the west side of the right-of-way at least to Middlebrook Road. In the Germantown area, the busway includes the option of departing from I-270 and following the alignments for Alternatives 1 and 8 through the Germantown office district. North of Germantown the route crosses I-270 to run either along the east side of the freeway or in the unused freeway median to a terminus approximately one mile north of MD 121.

3. **Alternative 8** - The alignment of this potential easement runs through undeveloped land west of the Shady Grove Metro station, through the Shady Grove Master Plan Area, and then runs parallel to Great Seneca Highway to the southwest

I-270 Corridor Cities Transit Easement Study

(continued)

boundary of the National Institute of Standards and Technology. It turns northeast, running parallel to Quince Orchard Road to the CSX right-of-way and Metropolitan Grove MARC station, just east of Clopper Road. North of Metropolitan Grove is similar to Alternative 1.

A second easement through Germantown on the east side of I-270 is optional. The east side easement, in addition to the west side easement for Alternatives 1, 3 and 8, was designated in the 1989 Germantown Master Plan. An amendment to the Shady Grove Study Area and Gaithersburg Vicinity Master Plans that modifies slightly the alignment is due to come before the Planning Board in the Spring of 1995.

Action Agenda

1991

The Action Agenda was prepared by the Growth Management Advisory Work Group. The 15 member Growth Management Advisory Group was formed to examine the process of managing growth in Montgomery County and the relationship between the factors regarding growth and the planning process. The Action Agenda was written to provide guidance to the Montgomery County Planning Board in the formulation of its long-range work program.

The recommendations of the Work Group are categorized into six areas: the framework for growth, the community, components of growth, constraints to growth, the economics of growth and growth management tools.

Transit recommendations of the Action Agenda are found primarily in the section entitled "Constraints to Growth" and are as follows:

- Continue to reassess the adequacy, compatibility, and effects of the planned transportation network, including both roads and transit.

- Study additional and creative ways to reduce traffic in different types of planning areas. Evaluate the degree to which transportation demand management can reduce congestion and increase cost-effectiveness of all types of transportation.

- Identify, reserve and establish priorities for funding new rights-of-way for highways, transitways, high-occupancy vehicle facilities, and other public rights-of-way in advance of development.

- Study changing travel patterns and travel behavior to determine 1) the portion of congestion due to population growth and the portion due to changing behavior and travel preferences, and 2) how land use and transportation planning decisions are affected by changing travel patterns.

- Develop a better understanding of people's real preferences with regard to transit alternatives to assist in deciding the types of transportation facilities that should be built and where.

Transportation Network Studies - Phase I

1992

This report documents the analysis and results of Phase I of the Transportation Network Studies conducted by the Montgomery County Planning Department during 1990 and 1991. The Transportation Network Studies (TNS) project identified general rights-of-way that are most appropriate for detailed evaluation for future use as transportation corridors served exclusively by transit or HOV vehicles and provided back up information on travel changes, and other actions to support the transitway recommendations.

General alignments were identified for a network totaling approximately 75 miles, primarily along existing roadway alignments in southeastern Montgomery County. The study recommended that this network of alignments be considered for preservation as part of a detailed evaluation of alternatives conducted through the master planning process.

Preservation of general rights-of-way for transitways or HOV priority lanes are recommended in the Transportation Network Studies - Phase I along the following roadways within the study area.

- I-270, between 1-495 and Shady Grove
- I-495, between Fairfax and Prince George's Counties
- US 29, between Silver Spring and Howard Counties
- Georgia Avenue, between Glenmont and Olney
- Veirs Mill Road, between the Montrose Parkway and University Boulevard
- University Boulevard, between Veirs Mill Road and Prince George's County
- Randolph Road, between Veirs Mill Road and Glenallen Road

Preservation of general rights-of-way are also recommended for three alignments not currently used for transportation, including:

- the alignment of the Montrose Parkway, (in the previous Rockville Facility alignment), I-270 and Veirs Mill Road,
- an alignment connecting Montgomery Mall to the Shady Grove planning area along the PEPCO power line easement and land adjacent to the proposed extension of Shady Grove Road, and
- an alignment connecting the Randolph Road transitway to US 29 at Fairland (south of Randolph Road) via the perimeter of parks and schoolyards.

The General Plan Refinement Of the Goals and Objectives for Montgomery County

December 1993

The General Plan Refinement was adopted by the County Council and approved by the Planning Board in 1993. It provides the basis for more specific area master plans, functional plans, and sector plans. Its purpose is to provide clear guidance regarding the general pattern of development in Montgomery County, while retaining enough flexibility to respond to unforeseeable circumstances as they arise.

The General Plan Refinement divided montgomery County into four geographic components: the Urban Ring, the Corridor, the Suburban Communities, and the Wedge. Each area is defined in terms of appropriate land uses, scale, intensity, and function. The geographic components provide a vision for the future while acknowledging the modifications to the Wedges and Corridors concept that have evolved during the past three decades. In particular, they confirm two distinct sub-areas of the Wedge — an Agricultural Wedge and a Residential Wedge. They also recognize the transitional areas of generally moderate density and suburban character that have evolved between the Wedge, Corridor, and Urban Ring as Suburban Communities. Emphasis remains on intensification of the Corridor, particularly along the main stem.

In addition to defining geographic components, the General Plan Refinement provides seven goals and associated objectives and strategies that give guidance to development within those components. The goals, objectives, and strategies provide a future vision for Montgomery County and establish a frame of reference for decision-making to make that vision become a reality. The seven goals are as follows:

Land Use

Achieve a variety of land uses and development densities consistent with the Wedges and Corridors pattern.

Housing

Encourage and maintain a wide choice of housing types and neighborhoods for people of all incomes, ages, lifestyles, and physical capabilities at appropriate densities and locations.

Economic Activity

Promote a healthy economy, including a broad range of business, service, and employment opportunities at appropriate locations.

General Plan Refinement

(continued)

Transportation

Provide a safe and efficient transportation system that serves the environmental, economic, social, and land use needs of the County and provides a framework for development.

Environment

Conserve and protect natural resources to provide a healthy and beautiful environment for present and future generations. Manage the impacts of human activity on our natural resources in a balanced manner to sustain human, plant, and animal life.

Community Identity and Design

Provide for attractive land uses that encourage opportunity for social interaction and promote community identity.

Regionalism

Promote regional cooperation and solutions of mutual concern to Montgomery County, its neighbors, and internal municipalities.

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